**IN THE UNITED STATES DISTRICT COURT**
**FOR THE WESTERN DISTRICT OF TEXAS**
**WACO DIVISION**

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| APEX BEAM TECHNOLOGIES LLC, | § | Case No. 6:24-cv-00223-ADA-DIG |
| Plaintiff, | § | **JURY TRIAL DEMANDED** |
| v. | § | |
| APPLE INC., | § | |
| Defendant. | § | |

## FIRST AMENDED COMPLAINT

Plaintiff Apex Beam Technologies LLC ("ABT" or "Plaintiff") for its First Amended Complaint against Defendant Apple Inc. ("Apple" or "Defendant"), alleges as follows:

## THE PARTIES

1. ABT is a limited liability company, organized and existing under the laws of the State of Texas, with its principal place of business located at 510 Austin Avenue, #25203, Waco, Texas 76701.

2. Apple is a California corporation and maintains its principal place of business located at One Apple Park Way, Cupertino, California 95014, and may be served with process through its registered agent, CT Corporation System at 1999 Bryan Street, Suite 900, Dallas, Texas 75201.

3. Apple does business in Texas, directly and/or indirectly, develops, designs, manufactures, distributes, markets, offers to sell and/or sells infringing products and services in the United States, including in the Western District of Texas, and otherwise directs infringing activities to this District in connection with its products and services.



APPLE 1017

4. On information and belief, Apple maintains regular and established places of business within this Judicial District, including at least the following locations: 12545 Riata Vista Circle, Austin, Texas 78727; 12801 Delcour Drive, Austin, Texas 78727; 5501-5505 W Parmer Lane, Austin, Texas; 6900 Parmer Lane, Austin, Texas; and 3121 Palm Way, Austin, Texas 78758. *See* https://www.apple.com/education/purchase/contracts/states/tx_dir.html. Upon information and belief, Defendant employs individuals in this Judicial District involved in the design, engineering, testing, sales, and marketing of its products.

## JURISDICTION

5. This is an action for patent infringement arising under the patent laws of the United States, 35 U.S.C. §§ 1, *et seq*. This Court has jurisdiction over this action pursuant to 28 U.S.C. §§ 1331, 1332, and 1338.

6. The amount in controversy exceeds $75,000.

7. This United States District Court for the Western District of Texas has general and specific personal jurisdiction over Defendant because, directly or through intermediaries, Defendant has committed acts within the District giving rise to this action and is present in and transacts and conducts business in and with residents of this District and the State of Texas.

8. Plaintiff's causes of action arise, at least in part, from Defendant's contacts with and activities in this District and the State of Texas. Apple conducts its business extensively throughout Texas and derives substantial revenue in Texas, by distributing products for which Apple has refused to offer fair, reasonable, and non-discriminatory license terms pursuant to its obligations. Apple's Austin-based employees received notice letters regarding Plaintiff's claims and regarding Apple's FRAND licensing obligations. Defendant has committed acts of infringing the Patents-in-Suit within this District and the State of Texas by making, using, selling, offering

for sale, and/or importing in or into this District and elsewhere in the State of Texas, products claimed by the Patents-in-Suit, including without limitation products made by practicing the claimed methods of the Patents-in-Suit. Defendant, directly and through intermediaries, makes, uses, sells, offers for sale, imports, ships, distributes, advertises, promotes, and/or otherwise commercializes such infringing products into this District and the State of Texas. Defendant regularly conducts and solicits business in, engages in other persistent courses of conduct in, and/or derives substantial revenue from goods and services provided to residents of this District and the State of Texas.

9. This Court has personal jurisdiction over Defendant pursuant to TEX. CIV. PRAC. & REM. CODE § 17.041 et seq. Apple is a multi-national company that has a significant presence in this District through the products and services Apple provides residents of this District. Apple regularly conducts business and has committed and benefitted from breach of FRAND obligations and unjust enrichment within this District that give rise to this action and have established minimum contacts within this forum, such that the exercise of jurisdiction over Apple would not offend traditional notions of fair play and substantial justice. Personal jurisdiction exists over Defendant because Defendant has minimum contacts with this forum as a result of business regularly conducted within the State of Texas and within this district, and, on information and belief, specifically as a result of, at least, committing the tort of patent infringement within Texas and this District. This Court has personal jurisdiction over Defendant, in part, because Defendant does continuous and systematic business in this District, including by providing infringing products and services to the residents of the Western District of Texas that Defendant knew would be used within this District, and by soliciting business from the residents of the Western District of Texas. For example, Defendant is subject to personal jurisdiction in this Court because, inter

alia, Defendant has regular and established places of business throughout this District, including at least at 12545 Riata Vista Circle, Austin, Texas 78727, and directly and through agents regularly does, solicits, and transacts business in the Western District of Texas. Also, Defendant has hired and is hiring within this District for positions that, on information and belief, relate to infringement of the Patents-in-Suit. Accordingly, this Court's jurisdiction over the Defendant comports with the constitutional standards of fair play and substantial justice and arises directly from the Defendant's purposeful minimum contacts with the State of Texas.

10. This Court also has personal jurisdiction over Defendant, because in addition to Defendant's own online website and advertising within this District, Defendant has also made its products available within this Judicial District and has advertised to residents within the District to hire employees to be located in this District.

11. Venue is proper in this Court under 28 U.S.C. § 1400(b) based on information set forth herein, which is hereby repeated and incorporated by reference. Further, upon information and belief, Defendant has committed or induced acts of infringement, and/or advertised, marketed, sold, and/or offered to sell products, including infringing products, in this District. In addition, and without limitation, Defendant has regular and established places of business throughout this District, including at least at 12545 Riata Vista Circle, Austin, Texas 78727.

12. On information and belief, Apple is one of the largest employers in the District, employing over seven thousand employees in the District with plans to increase its office space in the District to host up to another fifteen thousand employees. On information and belief, Apple has informed employees outside of Texas of requirements to relocate to this District. On information and belief, many of Apple's employees in the District are relevant fact witnesses and have knowledge that is relevant to the claims and defenses in this action. The below contains a

non-exhaustive listing of Apple employees across numerous relevant Apple teams located in this District that are relevant fact witnesses and have knowledge that is relevant to the claims and defenses of this action:

- Tony Pertro, Senior Legal Counsel at Apple Austin
- Jesse Koehler, Senior Counsel, IP Litigation at Apple Austin
- Ralph Wright, Manager, WW Contracts at Apple Austin
- Sanghyun Woo, RF Design Engineer at Apple Austin
- Kavya Gupta, RF Design at Apple Austin
- Rafaele Cetrulo RF Egnineer at Apple Austin
- Rishab Mehra, Design Engineer at Apple Austin
- Gautam Talreja, RF Cellular Design Engineer at Apple Austin
- Sanjeev Gokhale, Design Engineer at Apple Austin
- Mohamad Zeidan, RF LAB at Apple Austin
- Bill Hodges, SoC and Radio Engineer Project Manager at Apple Austin
- Ridhwan Khalid Mirza, Antenna Engineering at Apple Austin
- Harsha Hanumanthaiah, Wireless Engineer at Apple Austin
- Rama Sharma, Cellular Technologies and Standards at Apple Austin
- Shashank Natesh, Hardware Design Engineer at Apple Austin
- Menglou Rao, Antenna Design Engineer at Apple Austin
- Michael Frechette, RFIC Design Manager at Apple Austin
- Afradzuddin Zawair Mohammed, Cellular Engineer at Apple Austin
- Soonhyun Cha, Connectivity Engineer at Apple Austin
- Damian Ameen, RF Wirleess Engineering Project Manager at Apple Austin

- Yannick Leclercq, Senior Engineer (5G Modem, RF SOC) at Apple Austin
- Siva Bonasu, Hardware Engineer (5G Modem) at Apple Austin
- Amal Ekbal, Wireless System Engineer at Apple Austin
- Fabian Porta, Wireless iOS Carrier Engineering at Apple Austin
- Kumar Seethepalli, Cellular Engineer at Apple Austin
- Edgard Yemelong, Wireless Module Test Lead at Apple Austin
- Joseph Cramer, Senior Software Engineer (cellular modem, 5g) at Apple Austin

**PATENTS-IN-SUIT**

13. On October 29, 2019, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 10,462,767 (the "'767 Patent") entitled "Method and Device in UE and Base Station Used for Paging." A true and correct copy of the '767 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/10462767.

14. On February 18, 2020, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 10,568,113 (the "'113 Patent") entitled "Method and Device in UE and Base Station Used for Wireless Communication." A true and correct copy of the '113 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/10568113.

15. On February 2, 2021, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 10,912,081 (the "'081 Patent") entitled "Method and Device used for Wireless Communication in UE and Base Station." A true and correct copy of the '081 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/10912081.

16. On March 9, 2021, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 10,944,527 (the "'527 Patent") entitled "Method and Device for Multi-Antenna Transmission in UE and Base Station." A true and correct copy of the '527 Patent is

available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/10944527.

17. On March 16, 2021, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 10,951,271 (the "'271 Patent") entitled "Method and Device for Multi-Antenna Transmission in UE and Base Station." A true and correct copy of the '271 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/10951271.

18. On July 13, 2021, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 11,063,727 (the "'727 Patent") entitled "Method and Device in UE and Base Station for Multi-Antenna System." A true and correct copy of the '727 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/11063727.

19. On June 28, 2022, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 11,374,721 (the "'721 Patent") entitled "Method and Device for Wireless Communication." A true and correct copy of the '721 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/11374721.

20. On September 27, 2022, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 11,457,426 (the "'426 Patent") entitled "Method and Device in User Equipment (UE) and Base Station Used for Paging." A true and correct copy of the '426 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/11457426.

21. On January 3, 2023, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 11,546,110 (the "'110 Patent") entitled "Method and Device for Multi-Antenna Transmission in User Equipment (UE) and Base Station." A true and correct copy of the '110 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/11546110.

22. On April 11, 2023, the United States Patent and Trademark Office duly and legally

issued U.S. Patent No. 11,626,904 (the "'904 Patent") entitled "Method and Device for Multi-Antenna Transmission in User Equipment (UE) and Base Station." A true and correct copy of the '904 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/11626904.

23. On February 27, 2024, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 11,917,581 (the "'581 Patent") entitled "Method and Device in UE and Base Station Used for Paging." A true and correct copy of the '581 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/11917581.

24. On March 30, 2021, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 10,965,434 (the "'434 Patent") entitled "Scheduling Activation and Release." A true and correct copy of the '434 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/10965434.

25. On October 5, 2021, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 11,139,944 (the "'944 Patent") entitled "Validation of Downlink Control Information." A true and correct copy of the '944 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/11139944.

26. On August 31, 2021, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 11,108,639 (the "'639 Patent") entitled "Wireless Device Feedback for Semi-Persistent Scheduling Release." A true and correct copy of the '639 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/11108639.

27. On April 20, 2021, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 10,986,695 (the "'695 Patent") entitled "Uplink Cancellation Indication Signaling." A true and correct copy of the '695 Patent is available at https://image-

ppubs.uspto.gov/dirsearch-public/print/downloadPdf/10986695.

28. On April 13, 2021, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 10,979,128 (the "'128 Patent") entitled "Beam Failure and Consistent Listen Before Talk Failure Recovery." A true and correct copy of the '128 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/10979128.

29. On April 25, 2023, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 11,637,615 (the "'615 Patent") entitled "Random Access and Consistent LBT Failure Recovery." A true and correct copy of the '615 Patent is available at https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/11637615.

30. ABT is the sole and exclusive owner of all right, title, and interest in the '767 Patent, the '113 Patent, the '081 Patent, the '527 Patent, the '271 Patent, the '727 Patent, the '721 Patent, the '426 Patent, the '110 Patent, the '904 Patent, the '581 Patent, the '434 Patent, the '944 Patent, the '639 Patent, the '695 Patent, the '128 Patent, and the '615 Patent (collectively, the "Patents-in-Suit") and holds the exclusive right to take all actions necessary to enforce its rights to the Patents-in-Suit, including the filing of this patent infringement lawsuit. ABT also has the right to recover all damages for past, present, and future infringement of the Patents-in-Suit and to seek injunctive relief as appropriate under the law.

## FACTUAL ALLEGATIONS

### ETSI and 3GPP

31. It is critical for cellular communication network technology to be standardized around the globe. independent standard-setting organizations, like the European Telecommunications Standards Institute ("ETSI"), establish global standards for the telecommunication industries. ETSI, along with other standard-setting organizations, have made

it possible to have global interoperability between networks, devices, and network operators.

32. ETSI sets forth a policy in order to balance intellectual property protections against the need for an open standard by designating certain intellectual property rights (IPR) as "essential." ETSI sets forth the following definition of "essential":

> "ESSENTIAL" as applied to IPR means that it is not possible on technical (but not commercial) grounds, taking into account normal technical practice and the state of the art generally available at the time of standardization, to make, sell, lease, otherwise dispose of, repair, use or operate EQUIPMENT or METHODS which comply with a STANDARD without infringing that IPR. For the avoidance of doubt in exceptional cases where a STANDARD can only be implemented by technical solutions, all of which are infringements of IPRs, all such IPRs shall be considered ESSENTIAL.
> Clause 15.6 of the ETSI IPR Policy,

https://www.etsi.org/images/files/IPR/etsi-ipr-policy.pdf

33. Apple is an ETSI member, and has publicly stated its commitment to ETSI FRAND licensing in at least one letter to ETSI, stating that "Apple made its first cellular declaration to ETSI in 2007 . . . when it did, Apple committed to license its cellular standards essential patents under Fair, Reasonable, and Non-Discriminatory terms ("FRAND"). . ." https://www.apple.com/legal/intellectual-property/frand/ETSI-Letter-on-FRAND.pdf

34. Apple is required to have a license to one or more essential patents owned by ABT, including patents identified to Apple during the parties' negotiations.

**<u>The Parties' Negotiations</u>**

35. On May 15, 2023, James A. Trueman, Managing Director of ABT, mailed the correspondence excerpted below to Tony Pertro, Senior Legal Counsel at Apple, Jesse Koehler, Senior Counsel, IP Litigation at Apple, and Ralph Wright, Manager, WW Contracts at Apple, identifying certain Essential patents owned by Apex Beam (the "ABT SEPs") and offering Apple a license on FRAND terms.

Dear Mr. Koehler:

I am the Manager of Apex Beam Technologies LLC ("Apex Beam"). I am in charge of licensing and enforcement of Apex Beam's patent portfolio, which generally covers systems and methods for transmission schemes in wireless communication systems. We are writing to negotiate an amicable FRAND licensing arrangement between Apple and Apex Beam.

The patents in the Apex Beam portfolio are attached as Attachment A (the "Apex Beam Patents").

36. On June 5, 2023, Matt Clements, Senior Legal Counsel, IP Transactions, at Apple responded to Mr. Trueman via email with the correspondence excerpted below. Apple's response revealed that Apple had been aware of ABT's SEPs for at least six months before receiving ABT's correspondence. Upon information and belief, Apple was directed to ABTs detailed complaints for patent infringement showing how Apple's products are covered by the ABT SEPs in response to Apple's requests for "detailed claim charts" referenced therein.

37. ABT continued negotiations regarding a license to its Essential patents with third-party representatives of Apple for more than eight months following Mr. Clements June 5, 2023 letter but did not receive any counteroffer.

38. On April 15, 2024 Mr. Trueman responded to Mr. Clements via email with the correspondence excerpted below. The correspondence attached the complaints referenced therein.

Dear Mr. Clements:

As stated in our May 15, 2023 letter regarding the Apex Beam Patents[1], Apex Beam has attempted to negotiate in good faith an amicable FRAND licensing arrangement with Apple. Unfortunately, Apex Beam's attempt to negotiate a proposed rate based on "Apple 5G units and any future units that implement the technologies claimed in Apex Beam Patents" has been met with refusal to engage in any meaningful or substantive discussion.

While your June 5, 2023 letter identifies requests made to third parties (not Apex Beam) for additional information about the Apex Beam Patents, Apple omits that it has received and currently possesses knowledge of how the Apex Beam Patents have been mapped to the 5G standards. For example, it is our understanding that Apple has been directed to the publicly filed complaints against its competitors Samsung, TCL, OnePlus, and ZTE,[2] which explicitly set forth the mappings of Apex Beam's Patents to the 5G standards which are practiced by Apple's 5G-enabled products. These complaints yield the "details sufficient for [Apple] to conduct a meaningful investigation." We interpret Apple's conduct as part of a delay-to-pay strategy designed to continue deriving the unauthorized benefits of Apex Beam's patented technology. Though we have given Apple ample time to analyze these infringement mappings, Apple has not requested any further information or presented a counter-offer. Thus, our understanding is

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[1] See Attachment A to the May 15, 2023 correspondence from Trueman to Koehler.

[2] Apex Beam Technologies LLC v. Samsung Electronics Co. Ltd. et al, 2:22-00188-JRG (E.D. Tex., June 1, 2022); Apex Beam Technologies LLC v. TCT Mobile International Limited et al, 2:21-00438-JRG (E.D. Tex., Nov. 30, 2021); Apex Beam Technologies LLC v. OnePlus Technology (Shenzhen) Co. Ltd., 2:22-00032-JRG (E.D. Tex., Feb. 1, 2022); Apex Beam Technologies LLC v. ZTE Corporation, 2:22-00031-JRG (E.D. Tex., Feb. 1, 2022).

that Apple does not need any additional information and is refusing to make a counteroffer under FRAND.

As a practical and logical matter, any further delay by Apple in participating in a substantive dialog would leave Apex Beam with no choice but to suspend negotiations. We request that Apple provide Apex Beam with a substantive response which addresses the infringement mapping in the publicly filed cases and which includes a counterproposal on a royalty rate by close of business on April 24, 2024. Upon suspension of negotiations, Apex Beam will remain available to resume negotiations and will endeavor to exhaust all possible paths to arriving at an amicable FRAND licensing arrangement for the Apex Beam Patents.

As a courtesy, Apex Beam has provided additional copies of the Samsung, TCT, OnePlus, and ZTE complaints.

Sincerely,

James A. Trueman
Managing Director
Apex Beam Technologies LLC

APEX BEAM Technologies

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39. Apple failed to respond to Apex Beam's April 15 correspondence with any counteroffer as of April 24, 2024.

40. The Patents-in-Suit generally relate to systems and methods for transmission schemes in wireless communication systems.

41. The '767 Patent generally relates to technology that determines paging interval schedules that enable mobile handsets to be reached by paging with minimal complexity while maintaining low power consumption. The technology described in the '767 Patent was developed by Xiaobo Zhang of Shanghai Langbo Communication Technology Company Limited. By way of example, this technology is implemented today in the Accused Products (*e.g.,* 5G mobile handsets and tablets).

42. The ’113 Patent generally relates to technology that uses signal timing to improve signal delivery upon a beam recovery request. The technology described in the ’113 Patent was developed by Xiaobo Zhang of Shanghai Langbo Communication Technology Company Limited. By way of example, this technology is implemented today in the Accused Products (e.g., 5G mobile handsets and tablets).

43. The ’081 Patent generally relates to technology that uses symbol reception timing to determine beam or port location to improve communication quality. The technology described in the ’081 Patent was developed by Xiaobo Zhang of Shanghai Langbo Communication Technology Company Limited. By way of example, this technology is implemented today in the Accused Products (e.g., 5G mobile handsets).

44. The ’527 Patent generally relates to technology that provides mobile handsets with antenna virtualization information to determine correct beam alignment to enhance transmission quality. The technology described in the ’527 Patent was developed by Xiaobo Zhang of Shanghai Langbo Communication Technology Company Limited. By way of example, this technology is implemented today in the Accused Products (*e.g.*, 5G mobile handsets and tablets).

45. The ’271 Patent generally relates to technology that uses channel qualities and differential-based reporting compared to a threshold to assist in beam selection. The technology described in the ’271 Patent was developed by Xiaobo Zhang of Shanghai Langbo Communication Technology Company Limited. By way of example, this technology is implemented today in the Accused Products (e.g., 5G mobile handsets and tablets).

46. The ’727 Patent generally relates to a transmission scheme and device for a wireless communication system with a great many antennas deployed at a base station side. The technology described in the ’727 Patent was developed by Xiaobo Zhang of Shanghai Langbo Communication

Technology Company Limited. By way of example, this technology is implemented today in the Accused Products (*e.g.,* 5G mobile handset, tablets, and notebooks).

47. The ’721 Patent generally relates to a method and device related to uplink transmission. The technology described in the ’721 Patent was developed by Xiaobo Zhang of Shanghai Langbo Communication Technology Company Limited. By way of example, this technology is implemented today in the Accused Products (e.g., 5G mobile handsets, tablets, and notebooks).

48. The ’426 Patent generally relates to a method and a device for paging transmission in a communication system supporting multiple numerologies. The technology described in the ’426 Patent was developed by Xiaobo Zhang of Shanghai Langbo Communication Technology Company Limited. By way of example, this technology is implemented today in the Accused Products (e.g., 5G mobile handsets, tablets, and notebooks).

49. The ’110 Patent generally relates to a multiple antenna transmission method in a wireless communication system. The technology described in the ’110 Patent was developed by Xiaobo Zhang of Shanghai Langbo Communication Technology Company Limited. By way of example, this technology is implemented today in the Accused Products (*e.g.*, 5G mobile handsets, tablets, and notebooks).

50. The ’904 Patent generally relates to a scheme for multiple antenna transmission in a wireless communication system. The technology described in the ’904 Patent was developed by Xiaobo Zhang of Shanghai Langbo Communication Technology Company Limited. By way of example, this technology is implemented today in the Accused Products (*e.g.*, 5G mobile handsets, tablets, and notebooks).

51. The ’581 Patent generally relates to a method and a device for paging transmission in a communication system supporting multiple numerologies. The technology described in the ’581 Patent was developed by Xiaobo Zhang of Shanghai Langbo Communication Technology Company Limited. By way of example, this technology is implemented today in the Accused Products (e.g., 5G mobile handsets, tablets, and notebooks).

52. The ’434 Patent generally relates to technology that enables scheduling activation or scheduling release of semi-persistent or configured grants in a wireless device. The technology described in the ’434 Patent was developed by Alireza Babaei of PanPsy Technologies, LLC. By way of example, this technology is implemented today in the Accused Products (e.g., 5G mobile handsets and tablets).

53. The ’944 Patent generally relates to technology that enables scheduling activation or scheduling release of semi-persistent or configured grants in a wireless device. The technology described in the ’944 Patent was developed by Alireza Babaei of PanPsy Technologies, LLC. By way of example, this technology is implemented today in the Accused Products (*e.g.*, 5G mobile handsets and tablets).

54. The ’639 Patent generally relates to technology that enables wireless device feedback for semi-persistent scheduling release. The technology described in the ’639 Patent was developed by Alireza Babaei of PanPsy Technologies, LLC. By way of example, this technology is implemented today in the Accused Products (e.g., 5G mobile handsets and tablets).

55. The ’695 Patent generally relates to technology that enables signaling and determination of uplink cancellation indication in a wireless device. The technology described in the ’695 Patent was developed by Alireza Babaei of PanPsy Technologies, LLC. By way of example, this technology is implemented today in the Accused Products (*e.g.*, 5G mobile handsets

and tablets).

56. The ’128 Patent generally relates to technology for beam failure and enables consistent listen-before-talk (LBT) failure recovery. The technology described in the ’128 Patent was developed by Alireza Babaei of PanPsy Technologies, LLC. By way of example, this technology is implemented today in the Accused Products (*e.g.*, 5G mobile handsets and tablets).

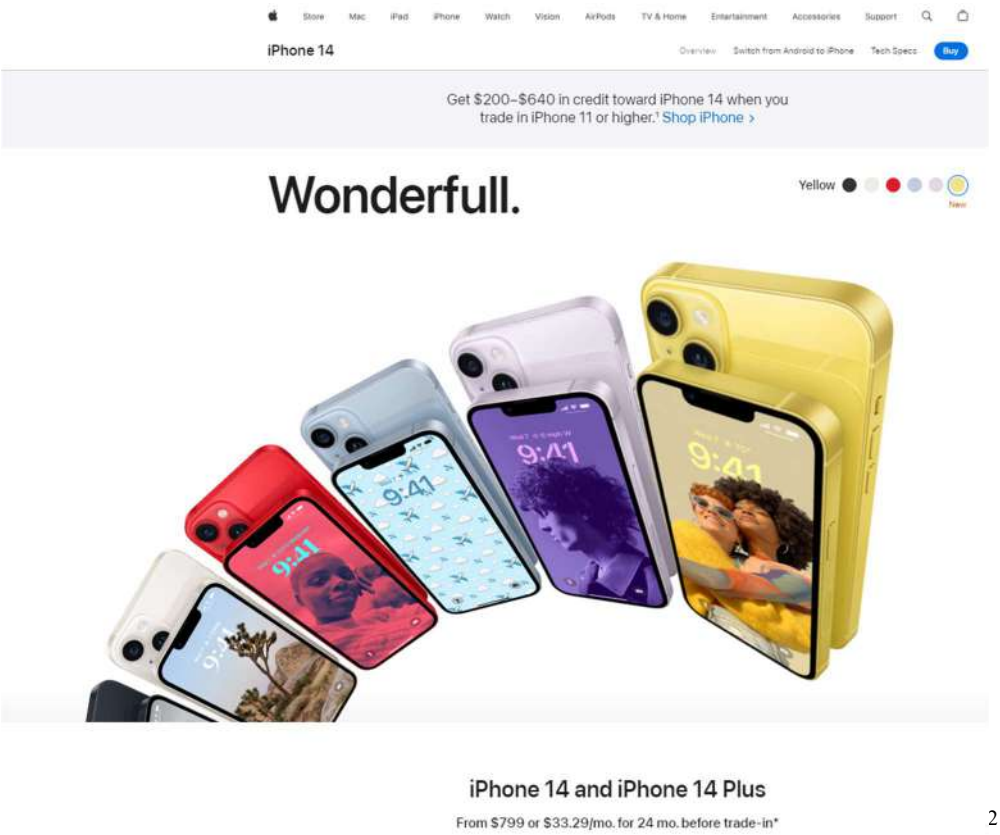
57. The ’615 Patent generally relates to technology for beam failure and enables consistent listen-before-talk (LBT) failure recovery. The technology described in the ’615 Patent was developed by Alireza Babaei of PanPsy Technologies, LLC. By way of example, this technology is implemented today in the Accused Products *(e.g.*, 5G mobile handsets and tablets).

58. Defendant has infringed and continue to infringe one or more of the Patents-in-Suit by making, using, selling, offering to sell, and/or importing, and by actively inducing others to make, use, sell, offer to sell, and/or import products, including handsets, tablets, smart devices, and chipsets thereof, that implement the 5G standards. For example, the Accused Products include, but are not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation).[1]

59. Defendant sells and offers to sell the Accused Products directly to customers and end-users in this District and throughout the United States through their website

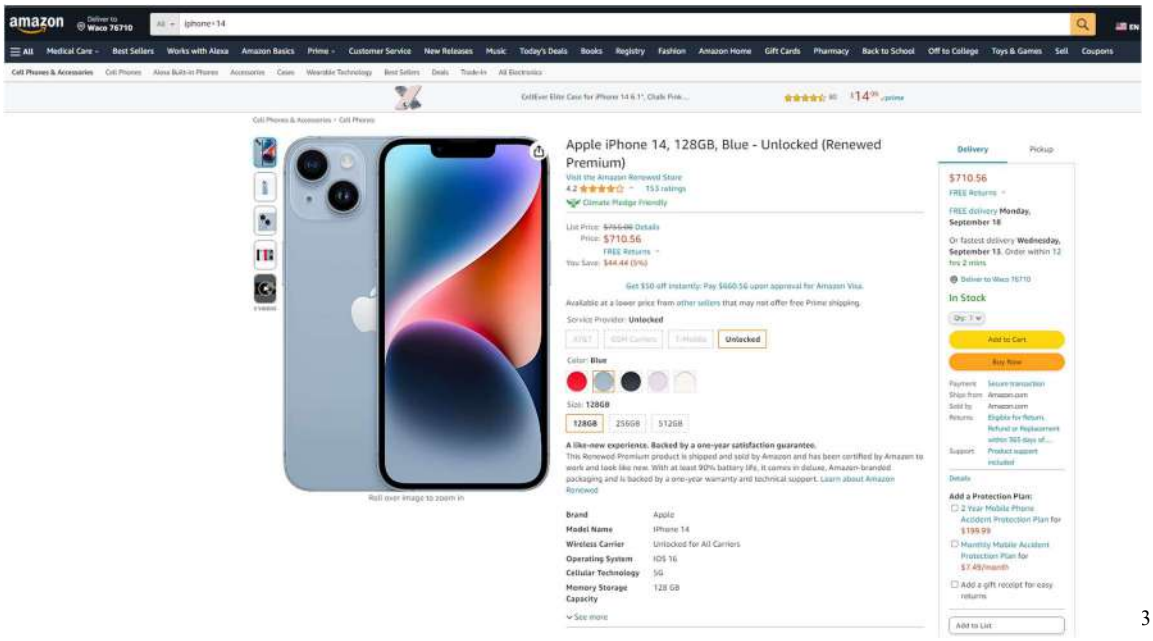
[1] https://support.apple.com/en-us/HT211828; https://www.apple.com/iphone/cellular/; https://www.apple.com/newsroom/2020/10/apple-announces-iphone-12-and-iphone-12-mini-a-new-era-for-iphone-with-5g/; https://www.apple.com/newsroom/2020/10/apple-introduces-iphone-12-pro-and-iphone-12-pro-max-with-5g/; https://www.apple.com/iphone-13-pro/index.html; https://support.apple.com/en-us/HT212196

(https://www.apple.com/store), as well as through online and physical stores, such as Amazon and Walmart.



[2]

[2] https://www.apple.com/iphone-14/

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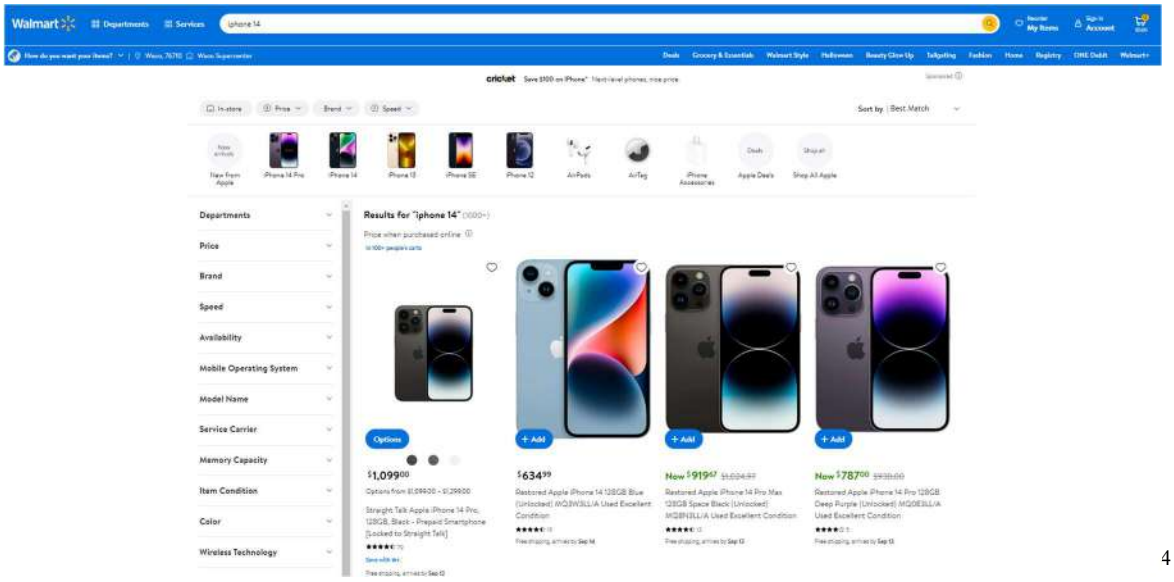


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60. Upon information and belief, Defendant also uses the Accused Products in this District and across the United States for demonstration, marketing, and creation of tutorials and instructions, to induce infringement by end users and other buyers.

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[3] https://www.amazon.com/TCL-Unlocked-Smartphone-Wireless-Cellphone/dp/B09728VTDK?th=1

[4] https://www.walmart.com/search?q=iphone+14

## COUNT I
## (Breach of Contract)

61. The preceding paragraphs are incorporated by reference as if fully set forth herein.

62. Apple designs, manufactures, and markets products that comply with 2G, 3G, 4G, and 5G standards.

63. The European Telecommunications Standards Institute (ETSI) Rules of Procedure Annex 6 at Clause 3.2 states:

> IPR holders, whether members of ETSI and their AFFILIATES or third parties, should be adequately and fairly rewarded for the use of their IPRs in the implementation of STANDARDS and TECHNICAL SPECIFICATIONS.

64. An implementer of an adopted standard who fails to negotiate in good faith towards a patent license agreement and thereby prevents a license from being granted on FRAND terms is liable to the patent holder for damages including, but not limited to, attorney's fees and the cost of litigation.

65. Apple has contractually committed to comply with such obligations, at least based on its ETSI membership, and its own declarations that its patents are Standard Essential.

66. ABT is an intended third-party beneficiary of Apple's contract with ETSI, and of the ETSI Rules and Policies pertaining to Standard Essential Patent declarations. ABT owns patents which have been declared Standard Essential to ETSI.

67. Since at least May 2023, representatives from ABT and Apple, as well as certain third parties representing Apple, have been engaged in negotiations regarding a license to the ABT SEPs, including the Patents-in-Suit.

68. Apple and its representatives have declined to respond to ABT with any proposed rate for a license to the ABT SEPs, including the Patents-in-Suit. In doing so, Apple violated its FRAND commitment by depriving ABT of its rights as a third-party beneficiary.

69. As an implementer of wireless standards for which Plaintiff's Patents-in-Suit are essential, as a signatory to ETSI, and having invoked FRAND obligations in its communications with Plaintiff and in prior litigation, Defendant is and has been obligated to negotiate in good faith towards a patent license agreement for these patents on FRAND terms, which it has not done. Defendant has failed to negotiate in good faith and has engaged in holdout behavior to extract unfair licensing terms.

70. Plaintiff, which has complied with ETSI's intellectual property policy and has negotiated in good faith, has been harmed by Defendant's breach of its FRAND obligations, wherein the damages include, but are not limited to, a rate to be determined by the Court and/or restitution sufficient to compensate Plaintiff for Defendant's failure engage in fair, reasonable, and non-discriminatory licensing terms, and the attorney's fees and the cost of litigation it has thus far incurred and is incurring in its attempts to compel Defendant to enter into a license on FRAND terms.

71. Plaintiff further requests a declaratory judgment that Apple has breached Apple's FRAND commitment, as set forth in its IPR licensing declarations to ETSI, as well as ETSI's IPR Policy and any applicable laws.

72. As a result of Defendant's breach of FRAND obligations, Plaintiff has suffered actual and consequential damages. To the fullest extent permitted by law, ABT seeks recovery of damages suffered from Apple's breach of its FRAND obligations.

## COUNT II
## (Unjust Enrichment)

73. The preceding paragraphs are incorporated by reference as if fully set forth herein.

74. In negotiations with ABT, Defendant has failed to negotiate in good faith and has engaged in holdout behavior to extract unfair licensing terms. In so doing, Defendant has been

unjustly enriched, as it has not paid licensing royalties to adequately and fairly reward ABT for the innovations of their SEP portfolio.

75. ABT, which has complied with ETSI's intellectual property policy and has negotiated in good faith, has been harmed by Defendant's failure to negotiate in good faith and holdout behavior.

76. As a result of Defendant's unjust enrichment, Plaintiff has suffered actual and consequential damages. To the fullest extent permitted by law, ABT seeks restitution to compensate for Apple's unjust enrichment.

**COUNT III**
**(Infringement of the '767 Patent)**

77. The preceding paragraphs are incorporated by reference as if fully set forth herein.

78. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the '767 Patent.

79. Defendant has and continues to directly infringe the '767 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '767 Patent. Such products include at least the Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which practice a method in a User Equipment (UE) for paging, comprising: monitoring a first signaling in X time intervals; and receiving a first radio signal; wherein X is a positive integer; the

first signaling is used for determining scheduling information for the first radio signal; the scheduling information comprises at least one of (occupied time-frequency resource, adopted Modulation Coding Scheme (MCS), subcarrier spacing of subcarriers in occupied frequency domain resource); the first radio signal carries a paging message; the frequency domain resource used for transmitting the first signaling belongs to a first subband; the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and at least one of (location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband) is used for determining the X time intervals.

80. For example, Defendant has and continues to directly infringe at least claim 11 of the '767 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards such as the Accused Products (*e.g.*, 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware for implementing 3rd Generation Partnership Product (3GPP) specifications).

81. The Accused Products monitor a first signaling (e.g., Paging DCI) in X time intervals (e.g., PDCCH monitoring occasions); and receiving a first radio signal (e.g., PCCH, PCH, or PDSCH); wherein X is a positive integer; the first signaling is used for determining scheduling information for the first radio signal; the scheduling information comprises at least one of occupied time-frequency resource, adopted Modulation Coding Scheme (MCS), subcarrier spacing of subcarriers in occupied frequency domain resource); the first radio signal carries a paging message; the frequency domain resource used for transmitting the first signaling belongs to a first subband (*e.g.*, a BWP); the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and at least one of (location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband) is used for determining the X time intervals.

82. For example, the Accused Products each perform the paging method defined in TS38.300 V15.3.0 Section 9.2.5, supplemented with procedures and definitions in TS38.101, TS38.211, TS38.212, TS38.213, TS38.214, TS38.300, TS8.304, TS38.321, and TS38.331).

83. For example, the Accused Products monitor a first signaling (e.g., paging DCI, P-RNTI) in X time intervals (e.g., paging occasion or PDCCH monitoring occasions) and receives a first radio signal (e.g., paging messages on the paging control channel/PDSCH) wherein X is a positive integer (e.g., multiple time slots).[5] For example, in the Accused Products, the first signaling (e.g., paging DCI, P-RNTI) is used for determining scheduling information for the first radio signal; the scheduling information comprises occupied time-frequency resource (e.g., frequency domain resource assignment; time domain resource assignment) and adopted Modulation Coding Scheme (MCS) (e.g., modulation and coding scheme).[6]

84. For example, the Accused Products practice the first radio signal (e.g., paging messages on the paging control channel/PDSCH) carries a paging message.7

85. For example, the frequency domain resource used for transmitting the first signaling (*e.g.*, PDSCH, PDCCH) belongs to a first subband (*e.g.*, bandwidth part). The bandwidth part (BWP) comprises of a set of Physical Resource Blocks (PRBs) which are measured from a reference resource block termed as Common Resource Block. As each of the Physical Resource Blocks comprises 12 subcarriers, the BWP comprises of a positive integer number of consecutive subcarriers in frequency domain.[8]

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[5] *See* TS38.304 V15.3.0, Section 7.1; TS38.212 V15.3.0, Section 4.2; and TS38.300 V15.5.0, Sections 6.2.2, 6.2.3, 9.2.5
[6] *See* TS38.212 V15.3.0, Section 7.3.1.2.1
[7] *See* TS38.300 V15.5.0, Section 6.2.2, 9.2.5
[8] *See* TS38.211 V15.2.0, Sections 4.4.5, 4.4.4.1, 4.2, 4.4.3, 4.4.4.3, 4.4.4.4; TS38.213 V15.3.0, Section 12; TS38.331 V15.3.0, Definition of BWP; TS38.321 V15.3.0, Section 5.15; TS38.101 V15.3.0, Sections 5.3.1, 5.3.2; TS38.214 V15.3.0, Section 5.1.2.2.2

86. For example, the location of the first subband in frequency domain (*e.g.*, pdcch-ConfigSIB1) and subcarrier spacing of subcarriers (*e.g.*, subcarrierSpacingCommon) included in the first subband (e.g., BWP) are used for determining X time intervals (*e.g.*, firstPDCCH-MonitoringOccasionOfPO).[9]

87. For example, in identifying the time interval of a subband, the subcarrier spacing information is sufficient to determine the time interval. The standard include a disclosure that the subcarrier spacing information provided by μ can be used to derive subband location (*e.g.*, BWP) with respect to a common resource block (*e.g.*, CRB0).[10]

88. For example, subcarrier spacing information (*e.g.*, subcarrierSpacingCommon) is already included in the MIB information element (such as the second radio signal) and can be transmitted from network to UE in BCH/BCCH channel (such as the claimed second radio signal).[11] The BWP information element comprises: 1) locationAndBandwidth; and 2) subcarrier spacing.[12]

89. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '767 Patent, as provided by 35 U.S.C. § 271(b), by knowingly and intentionally inducing infringement by others, such as Defendant's customers and end-users, in this District and elsewhere in the United States. For example, Defendant's customers and end-users directly infringe, either literally or under the doctrine of equivalents, by making, using, offering to sell, selling, and/or importing into the United States products that include infringing technology, such

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[9] *See* TS38.304 V15.3.0, Section 7.1; TS38.331 V15.3.0, Section 6.3.2, firstPDCCH-MonitoringOccasionOfPO
[10] *See* https://www.sharetechnote.com/html/5G/5G_ResourceGrid.html; https://www.rfwireless-world.com/5G/5G-NR-Resource-Grid-vs-Resource-Block-vs-Resource-Element.html
[11] *See* TS38.331 V15.3.0, Section 6.2.2, *MIB*
[12] *See* TS38.331 V15.3.0, Section 6.3.2, *BWP*

as Accused Products (*e.g.*, 5G mobile handsets and tablets). Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[13] Because of Defendant's inducement, Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '767 Patent. Defendant performs these affirmative acts with the intent to cause infringing acts by others or, in the alternative, with the belief that there was a high probability that others, including end-users, infringe the '767 Patent, but while remaining willfully blind to the infringement.

90. Defendant, with knowledge that these products, or the use thereof, infringe the '767 Patent at least as of the date of this Complaint, knowingly and intentionally induced, and continue to knowingly and intentionally induce direct infringement of the '767 Patent by providing these products to end-users for use in an infringing manner.

91. ABT has suffered damages as a result of Defendant's direct and indirect infringement of the '767 Patent in an amount to be proved at trial. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant's infringement of the '767 Patent, for which there is no adequate remedy at law, unless Defendant's infringement is enjoined by this

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[13] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

Court.

**COUNT IV**
**(Infringement of the ’113 Patent)**

92. The preceding paragraphs are incorporated by reference as if fully set forth herein.

93. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the ’113 Patent.

94. Defendant has and continues to directly infringe the ’113 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the ’113 Patent. Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which practice a method in a User Equipment (UE) for wireless communication, comprising: receiving a target radio signal; transmitting a first radio signal on a first channel; transmitting a second radio signal on a second channel; and monitoring a third radio signal in a first time window; wherein a measurement for the target radio signal obtains a target measurement value, the target measurement value, when higher than a target threshold is used for triggering the transmission of the first radio signal and the second radio signal; a time resource occupied by the first radio signal is used for determining the start time of the first time window; a time domain resource occupied by the first radio signal is used for determining a second time window, a time domain resource occupied by the second radio signal is within the second time window, and the second time window

is within the first time window; a time domain resource occupied by the second radio signal is used for determining a third time window, and the end time of the third time window is the end time of the first time window; and the second time window and the third time window have overlapped time domain resource(s).

95. For example, Defendant has and continues to directly infringe at least claim 11 of the ’113 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards, such as the Accused Products (*e.g.*, 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware for implementing 3rd Generation Partnership Product (3GPP) specifications).

96. The Accused Products receive a target radio signal (*e.g.*, SS); transmit a first radio signal (*e.g.*, MsgA) on a first channel (*e.g.*, PRACH, PUSCH); transmit a second radio signal (*e.g.*, PUSCH scheduled by a RAR UL grant) on a second channel (*e.g.*, PUSCH); and monitor a third radio signal in a first time window (*e.g.*, covering the time from the beginning of the second time window to the end of the third time window); wherein a measurement for the target radio signal obtains a target measurement value, the target measurement value, when higher than a target threshold is used for triggering the transmission of the first radio signal and the second radio signal; a time resource occupied by the first radio signal is used for determining the start time of the first time window; a time domain resource occupied by the first radio signal is used for determining a second time window (*e.g.*, *msgB-ResponseWindow* configured by RRC signaling), a time domain resource occupied by the second radio signal is within the second time window, and the second time window is within the first time window; a time domain resource occupied by the second radio signal is used for determining a third time window (*i.e.*, running time of *ra-ContentionResolutionTimer*), and the end time of the third time window is the end time of the first

time window; and the second time window and the third time window have overlapped time domain resource(s).

97. For example, the Accused Products practice a method for wireless communication defined in TS38.321 V16.1.0 Section 5.1 et seq., supplemented with procedures and definitions in TS38.213 and TS38.331.

98. For example, the Accused Products are configured to receive a target radio signal (*e.g.*, synchronization signal (SS)).[14]

99. For example, the Accused Products are configured to transmit a first radio signal (*e.g.*, Random Access Preamble for Msg1) on a first channel (*e.g.*, PRACH). For example, the "first radio signal" may additionally be "Msg1" OR "Random Access Preamble" and can be transmitted on PRACH (first channel) on a PRACH occasion.[15]

100. For example, the Accused Products are configured to transmits a second radio signal (*e.g.*, Msg3) on a second channel (*e.g.*, PUSCH scheduled by a RAR UL grant).[16]

101. For example, the Accused Products are configured to monitor (e.g., matches) a third radio signal (*e.g.*, UE contention Resolution Identity) in a first time window (*e.g.*, msgB-Response Window; ra-ContentionResolutionTimer).[17]

102. For example, a first time window covering "msgB-ResponseWindow" and "ra-Contention ResolutionTimer", which are triggered by the event that "fallbackRAR MAC subPDU" is detected in "msgB-ResponseWindow". For example, at least the MsgB received by the UE may satisfy the claimed third signal. For example, MsgB comprises of Msg2 and Msg4 for 2 -step RA

[14] *See* TS38.213 V16.0.0, Section 4.1
[15] *See* TS38.321 V16.1.0, Section 5.1.1
[16] *See* TS38.213 V16.0.0, Section 8; TS38.321 V16.0.0, Section, 5.1.4a
[17] *See* TS38.321 V16.0.0, Section, 5.1.4a; TS38.321 V16.0.0, Section 5.1.5

process. Therefore, the first time window may be completed as the UE receives the complete MsgB from the base station. The end of the MsgB response window may be the end of the first time window, whose indication is ra-ContentionResolutionTimer in section 5.1.5 TS 38.321 V16.0.0. The first-time window may start from the indication of ra-ResponseWindow.[18]

103. For example, the Accused Products practice a measurement for the target radio signal (*e.g.*, downlink pathloss reference) obtains a target measurement value (*e.g.*, RSRP), the target measurement value, when higher than (*e.g.*, above) a target threshold (*e.g.*, RSRP_THRESHOLD_RA_TYPE_SELECTION) is used for triggering the transmission of (*e.g.*, setting RA_TYPE to 2-stepRA) the first radio signal (*e.g.*, MsgA) and the second radio signal (*e.g.*, Msg3).19

104. For example, the Accused Products practice a time resource occupied by (*e.g.*, at the end of) the first radio signal (*e.g.*, MsgA) is used for determining (*e.g.*, at the first PDCCH occasion) the start time of the first time window (*e.g.*, a time window starting from the "second time window" and ending at the third time window).20

105. For example, the Accused Products practice a time domain resource occupied by the first radio signal (*e.g.*, MsgA) is used for determining (*e.g.*, at the first PDCCH occasion) a second time window (*e.g.*, msgB-ResponseWindow),[21]

106. For example, the Accused Products practice a time domain resource occupied by the second radio signal (*e.g.*, Msg3) is within the second time window (*e.g.*, msgB-ResponseWindow), and the second time window is within the first time window (*e.g.*, a time

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[18] *See* TS38.321 V16.0.0, Section 5.4.1
[19] *See* TS38.321 V16.0.0, Sections 5.1.1, 5.1.2a, 5.1.3a, 5.1.4a
[20] *See* TS38.321 V16.0.0, Section 5.1.4a
[21] *See* TS38.321 V16.0.0, Section 5.1.4a; TS38.331 V16.0.0, Section 6.3.2 *RACH-ConfigGenericTwoStepRA*, *msgB-ResponseWindow*

window starting from the "second time window" and ending at the third time window).[22]

107. For example, the Accused Products practice a time domain resource occupied by (*e.g.*, in the first symbol at the end of) the second radio signal (*e.g.* Msg3) is used for determining a third time window (*e.g.*, ra-ContentionResolutionTimer), and the end time of (*e.g.*, when the MAC PDU is successfully decoded) the third time window (*e.g.*, ra-ContentionResolutionTimer) is the end time of the first time window (*e.g.*, a time window starting from the "second time window" and ending at the third time window --- the end of the Random Access procedure). For example, when MAC PDU is successfully decoded, the ra-ContentionResolutionTimer is stopped (*i.e.*, the end of the third time window), and the UE will stop monitor the third radio signals (*i.e.*, the end of the first time window) no matter whether the decoded MAC PDU matches the CCCH SDU in Msg3 or not.23

108. For example, the Accused Products practice a second time window (e.g., msgB-ResponseWindow-r16) and the third time window (*e.g.*, the running time of ra-ContentionResolution timer which is essentially triggered by fallbackRAR) have overlapped time domain resources. As the fallbackRAR can be received at any time of the second time window, and hence without losing generality, the end of the second time window can be "after the beginning of the third time window" and "before the end of the third time window."[24]

109. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '113 Patent, as provided by 35 U.S.C. § 271(b), by knowingly and intentionally inducing infringement by others, such as Defendant's customers and end-users, in this District and

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[22] *See* TS38.321 V16.0.0, Section 5.1.4a
[23] *See* TS38.321 V16.0.0, Section 5.1.5
[24] *See* TS38.331 V16.0.0, Section 6.3.2 RACH-*ConfigGenericTwoStepRA*, *msgB-ResponseWindow*

elsewhere in the United States. For example, Defendant's customers and end-users directly infringe, either literally or under the doctrine of equivalents, by making, using, offering to sell, selling, and/or importing into the United States products that include infringing technology, such as Accused Products (*e.g.*, 5G mobile handsets and tablets). Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[25] Because of Defendant's inducement, Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '113 Patent. Defendant performs these affirmative acts with the intent to cause infringing acts by others or, in the alternative, with the belief that there was a high probability that others, including end-users, infringe the '113 Patent, but while remaining willfully blind to the infringement.

110. Defendant, with knowledge that these products, or the use thereof, infringe the '113 Patent at least as of the date of this Complaint, knowingly and intentionally induced, and continue to knowingly and intentionally induce direct infringement of the '113 Patent by providing these products to end-users for use in an infringing manner.

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[25] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

111. ABT has suffered damages as a result of Defendant's direct and indirect infringement of the '113 Patent in an amount to be proved at trial.

112. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant's infringement of the '113 Patent, for which there is no adequate remedy at law, unless Defendant's infringement is enjoined by this Court.

**COUNT V**
**(Infringement of the '081 Patent)**

113. The preceding paragraphs are incorporated by reference as if fully set forth herein.

114. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the '081 Patent.

115. Defendant has and continues to directly infringe the '081 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '081 Patent. Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which practice a method in a User Equipment (UE) for wireless communication, comprising: receiving a second radio signal; receiving a first radio signal; wherein the first radio signal is transmitted within a first time unit, a first bit block is used for generating the first radio signal, and the first radio signal comprises G multicarrier symbols; the second radio signal is transmitted within the first time unit, and the second radio signal is used for determining a time-

domain resource occupied by the G multicarrier symbols; as for any one given multicarrier symbol of the G multicarrier symbols, the multi-antenna related receiving for the given multicarrier symbol is related to the relative position of a time-domain resource occupied by the given multicarrier symbol with respect to a first time point in time domain; when the time-domain resource occupied by the given multicarrier symbol is behind the first time point, the second radio signal is used for determining the multi-antenna related receiving for the given multicarrier symbol; and when the time-domain resource occupied by the given multicarrier symbol is before the first time point, the multi-antenna related receiving for the given multicarrier symbol is related to the multi-antenna related receiving for the second radio signal; the first time point is one time point within the first time unit; and G is a positive integer.

116. For example, Defendant has and continues to directly infringe at least claim 9 of the ’081 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards, such as the Accused Products (*e.g.*, 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware for implementing 3rd Generation Partnership Product (3GPP) specifications).

117. The Accused Products comprise a first transceiver module, to receive a second radio signal (*e.g.*, DL DCI) and a first radio signal (*e.g.*, PDSCH); wherein the first radio signal is transmitted within a first time unit, a first bit block is used for generating the first radio signal, and the first radio signal comprises G multicarrier symbols; the second radio signal is transmitted within the first time unit, and the second radio signal is used for determining a time-domain resource (*e.g.*, time offset) occupied by the G multicarrier symbols; as for any one given multicarrier symbol of the G multicarrier symbols, the multi-antenna related receiving for the given multicarrier symbol is related to the relative position of a time-domain resource occupied by

the given multicarrier symbol with respect to a first time point (*e.g.*, reception time of DCL DCI delayed by *Threshold-Sched-Offset*) in time domain; when the time-domain resource occupied by the given multicarrier symbol is behind the first time point, the second radio signal is used for determining the multi-antenna related receiving for the given multicarrier symbol; and when the time-domain resource occupied by the given multicarrier symbol is before the first time point, the multi-antenna related receiving for the given multicarrier symbol is related to the multi-antenna related receiving for the second radio signal; the first time point is one time point within the first time unit; and G is a positive integer.

118. For example, the Accused Products practice a method for wireless communication defined in TS38.214 V15.2.0 Section 5.1.5, supplemented with procedures and definitions in TS38.306 and TS38.331.

119. For example, the Accused Products receive a second radio signal (*e.g.*, DL DCI).26

120. For example, the Accused Products receive a first radio signal (*e.g.*, a PDSCH corresponding to the DL DCI).27

121. For example, the first radio signal (*e.g.*, a PDSCH corresponding to the DL DCI) is transmitted within a first time unit (*e.g.*, the time between slot n and slot $\left\lfloor n \cdot \frac{2^{\mu_{PDSCH}}}{2^{\mu_{PDCCH}}} \right\rfloor + K_0$), a first bit block (*e.g.*, transport block) is used for generating (*e.g.*, using the modulation and coding scheme, number of layers, rate matching) the first radio signal (*e.g.*, a PDSCH corresponding to the DL DCI), and the first radio signal comprises G (*e.g.*, the number *L*) multicarrier symbols (*e.g.*, consecutive OFDM symbols).[28]

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[26] *See* TS38.214 V15.2.0, Section 5.1.5
[27] *See* TS38.214 V15.2.0, Section 5.1.5
[28] *See* TS38.214 V15.2.0, Sections 5.1.2.1, 5.1.3, 5.1.5

122. For example, the second radio signal (*e.g.*, DL DCI) is transmitted within the first time unit (*e.g.*, the slot with DL DCI), and the second radio signal (*e.g.*, DL DCI) is used for determining (*e.g.*, time domain resource assignment) a time-domain resource (*e.g.*, the slot offset $K_0$, and the start and length indicator SLIV) occupied by the G (*e.g.*, the number L) multicarrier symbols (*e.g.*, consecutive OFDM symbols).[29]

123. For example, for any one given multicarrier symbol of the G multicarrier symbols (*e.g.*, corresponding PDSCH), the multi-antenna related receiving (quasi-colocation parameters – *e.g.*, Doppler shift, Doppler spread, average delay, average spread, Spatial Rx parameter) for the given multicarrier symbol (*e.g.*, the first symbol of the corresponding PDSCH) is related to the relative position of a time-domain resource (*e.g.*, time offset between the reception of the DL-DCI and corresponding PDSCH) occupied by the given multicarrier symbol with respect to a first time point (*e.g.*, the reception time of the DL DCI delayed by Threshold-Sched-Offset) in time domain. For example, the first symbol of the PDSCH may be any multicarrier symbol. The Transmitting Antenna port may include a logical antenna port which is related to the QCL parameters. QCL can be used to support reception of both PDSCH and PDCCH at UE. In both cases, the gNB can indicate the antenna port used by a specific SS/PBCH block is QCL with the antenna port used by the PDSCH and PDCCH. Additionally, gNB can indicate that the antenna port used by specific CSI Reference signal is QCL with the antenna port used by PDSCH or PDCCH transmission. For example, all the G multicarrier symbols have the same relative position with respect to a first time point, *i.e.*, behind the first time point, or, in front of the first time point.[30]

[29] *See* TS38.214 V15.2.0, Section 5.1.5
[30] *See* TS38.214 V15.2.0, Section 5.1.5

124. For example, when the time-domain resource (*e.g.*, time offset between the reception of the DL-DCI and corresponding PDSCH) occupied by the given multicarrier symbol (*e.g.*, the first symbol of the corresponding PDSCH) is behind (*e.g.*, is equal to or greater than) the first time point (*e.g.*, the reception time of the DL DCI delayed by Threshold-Sched-Offset), the second radio signal (*e.g.*, detected PDCCH with DCI) is used for determining (*e.g.*, using the TCI-State according to the value of the 'Transmission Configuration Indication' field) the multi-antenna related receiving (*e.g.*, quasi-colocation parameters) for the given multicarrier symbol (*e.g.*, the first symbol of the corresponding PDSCH).[31]

125. For example, when the time-domain resource (*e.g.*, time offset between the reception of the DL-DCI and corresponding PDSCH) occupied by the given multicarrier symbol (*e.g.*, the first symbol of the corresponding PDSCH) is before (*e.g.*, less than) the first time point (*e.g.*, the reception time of the DL DCI delayed by Threshold-Sched-Offset), the multi-antenna related receiving (*e.g.*, quasi-colocation parameters) for the given multicarrier symbol (*e.g.*, the first symbol of the corresponding PDSCH) is related to (*e.g.*, is quasi-located with) the multi-antenna related receiving (*e.g.*, TCI state with respect to the QCL parameters(s)) for the second radio signal (*e.g.*, the PDCCH of the lowest CORESET-ID in the latest slot). For example, without loss of generality, the second radio signal belongs to a Searchspace being allocated with the lowest CORESET-ID in the latest slot.[32]

126. For example, the first time point (*e.g.*, the reception time of the DL DCI delayed by Threshold-Sched-Offset) is one time point within the first time unit (*e.g.*, the time between slot n and slot $\left\lfloor n \cdot \frac{2^{\mu_{PDSCH}}}{2^{\mu_{PDCCH}}} \right\rfloor + K_0$). G is a positive integer. For example, the Threshold-Sched-Offset can be OFDM

[31] *See* TS38.214 V15.2.0, Section 5.1.5
[32] *See* TS38.214 V15.2.0, Section 5.1.5

symbols, which is within the configuration scope of SLIV.[33]

127. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’081 Patent, as provided by 35 U.S.C. § 271(b), by knowingly and intentionally inducing infringement by others, such as Defendant’s customers and end-users, in this District and elsewhere in the United States. For example, Defendant’s customers and end-users directly infringe, either literally or under the doctrine of equivalents, by making, using, offering to sell, selling, and/or importing into the United States products that include infringing technology, such as Accused Products (*e.g.*, 5G mobile handsets and tablets). Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[34] Because of Defendant’s inducement, Defendant’s customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the ’767 Patent. Defendant performs these affirmative acts with the intent to cause infringing acts by others or, in the alternative, with the belief that there was a high probability that others, including end-users, infringe the ’081 Patent, but while remaining willfully blind to the infringement.

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[33] *See* TS38.214 V15.2.0, Sections 5.1.2.1, 5.1.5; TS38.306 V 15.3.0, Section 4.2.7.5; TS38.331 V 15.2.0, Section 6.3.3 *FeatureSetDownlink*

[34] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

128. Defendant, with knowledge that these products, or the use thereof, infringe the ’081 Patent at least as of the date of this Complaint, knowingly and intentionally induced, and continue to knowingly and intentionally induce direct infringement of the ’081 Patent by providing these products to end-users for use in an infringing manner.

129. ABT has suffered damages as a result of Defendant’s direct and indirect infringement of the ’081 Patent in an amount to be proved at trial.

130. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant’s infringement of the ’081 Patent, for which there is no adequate remedy at law, unless Defendant’s infringement is enjoined by this Court.

**COUNT VI**
**(Infringement of the ‘527 Patent)**

131. The preceding paragraphs are incorporated by reference as if fully set forth herein.

132. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the ’527 Patent.

133. Defendant has and continues to directly infringe the ’527 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the ’527 Patent. Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which practice a method for multi-antenna transmission in a user equipment, comprising: receiving

a first radio signal from a base station; and receiving a first signaling from the base station; wherein the first radio signal is transmitted by K antenna port groups of the base station; the antenna port group includes a positive integer number of antenna port(s); a first antenna port group is one of the K antenna port groups; the first signaling is used to determine a first time resource pool; at least one of a first antenna virtualization vector and a second antenna virtualization vector is associated with the first antenna port group; the first antenna virtualization vector is an antenna virtualization vector available to the base station in the first time resource pool; the second antenna virtualization vector is an antenna virtualization vector available to the user equipment in the first time resource pool; and the K is a positive integer greater than 1.

134. For example, Defendant has and continues to directly infringe at least claim 11 of the '527 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards, such as the Accused Products (*e.g.*, 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware for implementing 3rd Generation Partnership Product (3GPP) specifications).

135. The Accused Products receive a first radio signal (*e.g.*, KCSI-RSresources and/or SS/PBCH blockresources) from a base station; and receive a first signaling (*e.g.*, a DCI format signal) from the base station; wherein the first radio signal is transmitted by K antenna port groups (*e.g.*, ports in the KCSI-RSresources and/or SS/PBCH blockresources) of the base station; the antenna port group includes a positive integer number of antenna port(s); a first antenna port group (*e.g.*, ports in a CSI-RS resource or SS/PBCH block resource) is one of the K antenna port groups; the first signaling is used to determine a first time resource pool (*e.g.*, time domain resource occupied by a PDSCH, ); at least one of a first antenna virtualization vector and a second antenna virtualization vector (*e.g.*, Rx or Tx antenna virtualization vector) is associated with the first

antenna port group; the first antenna virtualization vector is an antenna virtualization vector available to the base station in the first time resource pool; the second antenna virtualization vector is an antenna virtualization vector available to the user equipment in the first time resource pool; and the K is a positive integer greater than 1.

136. For example, the Accused Products practice a method for wireless communication defined in TS38.214 V15.2.0 Section 6.2.1, supplemented with procedures and definitions in TS38.202, TS38.212, TS38.213, TS38.214, and TS38.331.

137. For example, the Accused Products receive a first radio signal (*e.g.*, CSI-RS or SS/PBCH) from a base station (*e.g.*, gNB). For example, the first radio signal comprises CSI-RSresources and/or SS/PBCH Block resources.[35]

138. For example, the Accused Products receive a first signaling (e.g., SearchSpace IE, ConfiguredGrantConf IE, DCI format 1_0, DCI format 1_1, or DCI format 0_1) from the base station.[36]

139. For example. the first radio signal (*e.g.*, CSI-RS or SS/PBCH) is transmitted by K antenna port groups of the base station. For example, the first radio signal comprises K CSI-RS resources / SS/PBCH block resources. The K antenna port groups correspond to the K CSI-RS resources / SS/PBCH block resources, respectively, with each antenna port group comprises one or more ports included in the corresponding CSI-RS resource / SS/PBCH block resources. The antenna port group includes a positive integer number of antenna port(s) (*e.g.*, number of ports). A first antenna port group (*e.g.*, one or more ports included in one CSI-RS or SS/PBCH) is one of

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[35] *See* TS38.214 V15.0.0, Sections 5.2.1, 5.2.1.2

[36] *See* TS38.331 V15.1.0, Section 6.3.2 *SearchSpace*, *ConfiguredGrantConfig*; TS38.212 V15.0.0, Sections 7.3.1.2.1, 7.3.1.2.2, 7.3.1.1.2; TS38.214 V15.0.0, Section 6.2.1; TS38.331 V15.1.0, Section 6.3.2 *SRS-Config*

the K antenna port groups.[37]

140. For example, the first time resource pool is the time domain resource occupied by a search space set. In other examples, the first time resource pool is the time domain resource occupied by a PUSCH. In other examples, the first time resource pool is the time domain resource occupied by a PDSCH or an SRS resource. In one example, the first signaling (*e.g.*, IE SearchSpace) is used to determine a first time resource pool (*e.g.*, monitoringSlotPeriodicityAndOffset; monitoringSymbolsWithinSlot). In another example, the first signaling (*e.g.*, IE ConfiguredGrantConfig) is used to determine a first time resource pool (e.g., timeDomainOffset; timeDomainAllocation). In another example, the first signaling (*e.g.*, DCI format 1_0; DCI format 1_1; DCI format 0_1) is used to determine a first time resource pool (*e.g.*, time domain resource assignment). In another example, the first signaling (*e.g.*, SRS-ResourceConfig) is used to determine a first time resource pool (e.g., Slot level periodicity; slot level offset; number of OFDM symbols in the SRS resource; starting OFDM symbol of the SRS resource within a slot including repetition factor R). In another example, the first signaling (*e.g.*, SRS-Config IE) is used to determine a first time resource pool (*e.g.*, startPosition; nrofSymbols; repetitionFactor).[38]

141. For example. the selection of the receiving depends on, for example, the QCL obtained and on the basis of that a spatial Receive (Rx) parameter is used by the UE as recited in claim element 1E. For example, according to TS38.331 v15.1.0 – clause 6.3.2, a search space set is associated with a CORESET. According to D2 – clause 10.1, a TCI-state is configured for a CORESET, which indicates at least one RS (CSI-RS or SS/PBCH, see TS38.331 v15.1.0 clause

[37] TS38.214 V15.0.0, Section 5.2.1.2
[38] TS38.331 V15.1.0, Section 6.3.2 *SearchSpace*, *ConfiguredGrantConfig*, *SRS-Config*; TS38.212 V15.0.0, Sections 7.3.1.2.1, 7.3.1.2.2, 7.3.1.1.2; TS38.214 V15.0.0, Section 6.2.1

6.2.3) providing QCL information for PDCCH reception in this CORESET (*i.e.*, in the associated search space set in the first time resource pool). The first antenna port group contains the port(s) of the RS indicated by the TCI state. According to the definition of QCL in TS 38.214 v15.0.0 – clause 5.1.5, the QCL information include spatial Rx parameters. Spatial Rx parameters include Rx antenna vitalization vector. Therefore, the second antenna virtualization vector is associated with the first antenna port group. In another example, according to TS38.331 v15.1.0 clause 6.3.2 and TS38.212 v15.0.0 – clause 7.3.1.1.2, an SRI (SRS resource indicator) is indicated for a PUSCH (i.e., in the first time resource pool). The SRI indicates an SRS resource which is further associated with a CSI-RS or SS/PBCH (*see* TS38.214 v15.0.0 – clause 6.2.1). The first antenna port group contains port(s) of the CSI-RS or SS/PBCH associated with the SRS resource indicated by the SRI. According to TS38.214 v15.0.0 – clause 6.1.1, a PUSCH is transmitted over the ports in the SRS resource indicated by SRI, which means that the UE uses the same spatial domain transmission filter to transmit the PUSCH and the SRS resource indicated by SRI. According to TS38.214 v15.0.0 – clause 6.2.1, a UE transmit the SRS resource, *i.e.*, the PUSCH in the first time resource pool, with the same spatial domain transmission filter used for the reception of the associated CSI-RS or SS/PBCH. The spatial domain transmission filter includes a transmit antenna virtualization vector, so the second antenna virtualization vector is associated with the first antenna port group. In another example, according to TS38.214 v15.0.0 – clause 5.1.5, when there is no TCI field in a DCI (*e.g.*, DCI format 1_0), a default TCI state is used for the PDSCH (*i.e.*, in the first time resource pool). The first antenna port group contains port(s) of the RS indicated by the default TCI state. According to the definition of QCL in TS38.214 v15.0.0 – clause 5.1.5, the QCL information includes spatial Rx parameters. Spatial Rx parameters include Rx antenna virtualization vector. Therefore, the second antenna virtualization vector is associated with the first

antenna port group. In another example, according to TS38.212 v15.0.0 – clause 7.3.1.2.2, a TCI (Transmission Configuration Indication) state is indicated in DCI format 1_1 for a PDSCH (*i.e.*, in the first time resource pool), which refers to a CSI-RS or SS/PBCH for QCL information. The first antenna port group contains port(s) of the RS indicated by the TCI state. According to the definition of QCL in TS38.214 v15.0.0 – clause 5.1.5, the QCL information includes spatial Rx parameters. Spatial Rx parameters include the Rx antenna virtualization vector. Therefore, the second antenna virtualization vector is associated with the first antenna port group. In another example, according to TS38.214 v15.0.0 – clause 6.2.1, a CSI-RS or SS/PBCH is configured for an SRS resource (*i.e.*, in the first time resource pool), and a UE transmit the SRS resource with the same spatial domain transmission filter used for the reception of the CSI-RS or SS/PBCH. The first antenna port group contains port(s) of the CSI-RS or SS/PBCH. The spatial domain transmission filter includes a transmit antenna virtualization vector, so the second antenna virtualization vector is associated with the first antenna port group.[39]

142. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '527 Patent, as provided by 35 U.S.C. § 271(b), by knowingly and intentionally inducing infringement by others, such as Defendant's customers and end-users, in this District and elsewhere in the United States. For example, Defendant's customers and end-users directly infringe, either literally or under the doctrine of equivalents, by making, using, offering to sell, selling, and/or importing into the United States products that include infringing technology, such as Accused Products (*e.g.*, 5G mobile handsets and tablets). Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise

[39] TS38.331 V15.1.0, Section 6.3.2 *Search Space*, *rrc-ConfiguredUplinkGrant*, *SRS-Config*, TCI-State; TS38.213 V15.0.0, Section 10.1; TS38.214 V15.0.0, Sections 5.1.5, 6.1.1.1, 6.1.1.2, 6.2.1; TS38.212 V15.0.0, Sections 7.3.1.2.2, 7.3.1.1.2

making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[40] Because of Defendant's inducement, Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '527 Patent. Defendant performs these affirmative acts with the intent to cause infringing acts by others or, in the alternative, with the belief that there was a high probability that others, including end-users, infringe the '527 Patent, but while remaining willfully blind to the infringement.

143. Defendant, with knowledge that these products, or the use thereof, infringes the '767 Patent at least as of the date of this Complaint, knowingly and intentionally induced, and continue to knowingly and intentionally induce direct infringement of the '527 Patent by providing these products to end-users for use in an infringing manner.

144. ABT has suffered damages as a result of Defendant's direct and indirect infringement of the '527 Patent in an amount to be proved at trial.

145. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant's infringement of the '527 Patent, for which there is no adequate remedy at law, unless Defendant's infringement is enjoined by this Court.

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[40] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

## COUNT VII
## (Infringement of the ’271 Patent)

146. The preceding paragraphs are incorporated by reference as if fully set forth herein.

147. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the ’271 Patent.

148. Defendant has and continues to directly infringe the ’271 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the ’271 Patent. Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which practice a method for multi-antenna transmission in a user equipment (UE), comprising: receiving, by the UE, a first signaling originating from a base station; receiving, by the UE, a first wireless signal originating from the base station; and transmitting, by the UE, first information to the base station; wherein, K antenna port groups of the base station are used to transmit the first wireless signal; the first signaling is used by the UE to determine the K antenna port groups transmitting the first wireless signal received by the UE; the K is a positive integer greater than 1; the K antenna port groups respectively correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs); K1 antenna port groups of the K antenna port groups correspond to K1 channel quality values of

the K channel quality values; the K1 is a positive integer less than or equal to the K; a first proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values; the first information is used to determine the K1 antenna port groups and the first proportional sequence; the first signaling is used to determine a target threshold; the target threshold is a non-negative real number; a first channel quality is a best channel quality value among the K1 channel quality values; a second channel quality is a worse channel quality value among the K1 channel quality values; a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold.

149. For example, Defendant has and continues to directly infringe at least claim 11 of the ’271 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards, such as the Accused Products (e.g., 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware for implementing 3rd Generation Partnership Product (3GPP) specifications).

150. The Accused Products receive, by the UE, a first signaling (e.g., CSI-ReportConfig IE or CSI-AperiodicTriggerStateList IE) originating from a base station; receive, by the UE, a first wireless signal (e.g., K CSI-RS resources and/or SS/PBCH block resources) originating from the base station; and transmitting, by the UE, first information (CSI report) to the base station; wherein, K antenna port groups (*e.g.*, ports in the K CSI-RS resources and/or SS/PBCH block resources) of the base station are used to transmit the first wireless signal; the first signaling is used by the UE to determine the K antenna port groups transmitting the first wireless signal received by the UE; the K is a positive integer greater than 1; the K antenna port groups respectively correspond to K channel quality values (*e.g.*, K L1-RSRPs corresponding to K CSI-RS resources and/or SS/PBCH block resources); the K channel quality values are K non-negative real numbers; the K channel

quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs); K1 (e.g., nrofReportedRS) antenna port groups (*e.g.*, antenna port groups corresponding to nrofReportedRS CSI-RS resources and/or SS/PBCH block resources reported in a single CSI report) of the K antenna port groups correspond to K1 channel quality values (*e.g.*, nrofReportedRS L1-RSRPs corresponding to nrofReportedRS CSI-RS resources and/or SS/PBCH block resources reported in a single CSI report) of the K channel quality values; the K1 is a positive integer less than or equal to the K; a first proportional sequence (*e.g.*, the linear values of (nrofReportedRS-1) differential L1-RSRPs) corresponds to a ratio (ratios) among the K1 channel quality values; the first information is used to determine the K1 antenna port groups and the first proportional sequence; the first signaling is used to determine a target threshold (*e.g.*, the minimum value of the ratio between the worst one and the best one of the K1 L1-RSRPs); the target threshold is a non-negative real number; a first channel quality (*i.e.*, the best one of the nrofReporteedRS L1-RSRPs) is a best channel quality value among the K1 channel quality values; a second channel quality (one of the nrofReportedRS L1-RSRPs other than the best one of the nrofReportedRS L1-RSRPs) is a worse channel quality value among the K1 channel quality values; a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold.

151. For example, the Accused Products practice a method for wireless communication defined in TS38.214 V15.2.0 Section 6.2.1, supplemented with procedures and definitions in TS38.133, TS38.202, TS38.213, TS38.214, TS38.215, TS38.321, and TS38.331.

152. For example, the Accused Products practice a method for multi-antenna transmission in a User Equipment (UE).[41]

[41] *See* TS38.202 V15.1.0

153. For example, the Accused Products practice receiving a first signaling (*e.g.*, CSI-ReportConfig) originating from a base station (*e.g.*, gNB).[42]

154. For example, the Accused Products receive a first wireless signal (*e.g.*, CSI-RS resources; SS/PBCH Block resources) originating from the base station (*e.g.*, gNB). For example, the first wireless signal comprises K CSI-RS resources and/or SS/PBCH block resources. More specifically, the first wireless signal comprises K CSI-RS resource and/or SS/PBCH block resources configured in a CSI resource setting (by a CSI-ResourceConfig IE) for channel measurement in a CSI-ReportConfig IE.[43]

155. For example, the Accused Products transmit first information (*e.g.*, a single CSI report) to the base station (e.g., gNB).[44]

156. For example, K antenna port groups (*e.g.*, number of ports) of the base station are used to transmit the first wireless signal (*e.g.*, CSI-RS resources; SS/PBCH Block resources).[45]

157. For example, the first signaling (*e.g.*, CSI-ReportConfig) is used by the Accused Products to determine the K antenna port groups (*e.g.*, number of ports – nrofPorts) transmitting the first wireless signal (*e.g.*, CSI-RS resources; SS/PBCH Block resources) received by the UE. K is a positive integer greater than 1.[46]

158. For example, the K antenna port groups (e.g., number of ports transmitting the first wireless signal) respectively correspond to K channel quality values (*e.g.*, Reference Signal Received Powers, L1-RSRP). The K channel quality values are K non-negative real numbers (*e.g.*,

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[42] *See* TS38.214 V15.0.0, Section 5.2.1; TS38.331 V15.1.0, 6.3.2 CSI-*ReportConfig*
[43] *See* TS38.214 V15.0.0, Section 5.2.1; TS38.214 V15.0.0, Section 5.2.1.2
[44] *See* TS38.214 V15.0.0, Section 5.2.1; TS38.214 V15.0.0, Section 5.2.1.4
[45] *See* TS38.214 V15.0.0, Section 5.2.1.2
[46] *See* TS38.331 V15.1.0, Section 6.3.2 *CSI-ReportConfig*, *CSI-ResourceConfig*, *NZP-CSI-RS-ResourceSet*, *CSI-SSB-ResourceSet*, *NZP-CSI-RS-Resource*, *CSI-RS-ResourceMapping*

L1-RSRP are in Watts(W)).[47]

159. For example, the K1 antenna port groups of the K antenna port groups (*e.g.*, nrofReportedRS) correspond to K1 channel quality values of the K channel quality values (*e.g.*, L1-RSRP). the K1 is a positive integer less than or equal to the K. For example, the K1 channel quality values are K1 L1-RSRPs in W (watts). As shown in claim element 1[F], the linear L1-RSRP *i.e.*, RSRP of layer 1 signals such as SS or CSI RS are stated in W(watts).[48]

160. For example, a first proportional sequence (*e.g.*, the differential L1-RSRP in dB) corresponds to a ratio(ratios) among the K1 channel quality values (*e.g.*, between linear L1-RSRPs in W). For example, the differential L1-RSRP in dB is equivalent to the ratio(ratios) between linear L1-RSRPs in W. The reported value in table 10.1.6.1-2 of TS 38.133 is in dB (decibels). W units can be converted into dB units because both represent power.[49]

161. For example, the first information (*e.g.*, a single CSI report) is used to determine the K1 antenna port groups *(e.g.*, nrofReportedRS) and the first proportional sequence (*e.g.*, the largest L1-RSRP and differential L1-RSRP). For example, the first proportional sequence depends upon the K1 channel quality values. As shown in the mapping the K1 antenna port groups are determined via CSI RS/SS resources comprising of first information. The Accused Products use the largest L1-RSRP and differential L1-RSRP which are quantized to a 7-bit value in the range [-140, -44] dBm and 4-bit value respectively as shown in section 5.2.1.4.3 TS38.214 V15.3.0. The quantized value is the first proportional sequence.[50]

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[47] *See* TS38.214 V15.0.0, Section 5.2.1.2; TS38.215 V15.0.0, Sections 5.1.1, 5.1.2
[48] *See* TS38.214 V15.0.0, Section 5.2.1.4
[49] *See* TS38.214 V15.0.0, Section 5.2.1.4; TS38.133 V15.8.0, Table 10.1.5.1-2
[50] *See* TS38.214 V15.0.0, Section 5.2.1.4

162. For example, the first signaling (*e.g.*, CSI-ReportConfig) is used to determine a target threshold (*e.g.*, QinL,R). QinL,R is a non-negative real number. For example, the first channel quality (*e.g.*, best L1=RSRP) is a best channel quality value among the K1 channel quality values. A second channel quality is a worse channel quality value (*e.g.*, worst L1=RSRP) among the K1 channel quality values; a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold (*e.g.*, QinL,R). The threshold, QinL,R, corresponds to the channel quality measurements. For example, the first signaling indicates nrofReportedRS. With nrofReportedRS, and fixed values of (see TS38.214 v.15.0.0 – clause 5.2.1.4) the number of bits per differential L1-RSRP and the step size of differential L1-RSRP, the minimum value (*i.e.* the target threshold) of the ratio between the worst L1-RSRP and the best L1-RSRP (*i.e.*, the first channel quality) can be obtained as $Th = -(N_{RS} - 1) \cdot 2^{N_{bit}} \cdot 2$ (dB) with Th the target threshold, NRS = nrofReportedRS, Nbit = number of bits per differential L1-RSRP. For example, the ratio between any L1-RSRP other than the best L1-RSRP (the second channel quality) and the best L1-RSRP (*i.e.*, the first channel quality) is no smaller than the target threshold.[51]

163. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’271 Patent, as provided by 35 U.S.C. § 271(b), by knowingly and intentionally inducing infringement by others, such as Defendant’s customers and end-users, in this District and elsewhere in the United States. For example, Defendant’s customers and end-users directly infringe, either literally or under the doctrine of equivalents, by making, using, offering to sell, selling, and/or importing into the United States products that include infringing technology, such as Accused Products (*e.g.*, 5G mobile handsets and tablets). Defendant induces this direct

[51] *See* TS38.331 V15.1.0, Section 6.3.2 CSI-*ReportConfig*; TS38.214 V15.0.0, Section 5.2.1.4; TS 38.213 V15.3.0, Section 6; TS 38.321 V15.3.0, Section 5.1.1

infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[52] Because of Defendant's inducement, Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '271 Patent. Defendant performs these affirmative acts with the intent to cause infringing acts by others or, in the alternative, with the belief that there was a high probability that others, including end-users, infringe the '271 Patent, but while remaining willfully blind to the infringement.

164. Defendant, with knowledge that these products, or the use thereof, infringe the '271 Patent at least as of the date of this Complaint, knowingly and intentionally induced, and continue to knowingly and intentionally induce direct infringement of the '271 Patent by providing these products to end-users for use in an infringing manner.

165. ABT has suffered damages as a result of Defendant's direct and indirect infringement of the '271 Patent in an amount to be proved at trial.

166. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant's infringement of the '271 Patent, for which there is no adequate remedy at law, unless Defendant's infringement is enjoined by this Court.

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[52] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

## COUNT VIII
## (Infringement of the ’727 Patent)

167. The preceding paragraphs are incorporated by reference as if fully set forth herein.

168. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the ’727 Patent.

169. Defendant has and continues to directly infringe the ’727 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the ’727 Patent. Such products include at least the Accused Products including, but not limited to, the Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which each are a User Equipment (UE) for multi-antenna transmission, comprising: a first receiver: receiving a first signaling, a second signaling, a first reference signal and a second reference signal; and a first transmitter: transmitting first channel information; wherein the first reference signal comprises Q1 reference signal port(s), the Q1 reference signal port(s) is(are) transmitted by Q1 antenna port(s) respectively; the second reference signal comprises Q2 reference signal port(s), the Q2 reference signal port(s) is(are) transmitted by Q2 antenna port(s) respectively; the first signaling is used to determine L1 antenna port(s), the Q1 antenna port(s) is(are) a subset of the L1 antenna port(s); the second signaling is used to determine the Q2 antenna port(s); wherein the Q1 and the Q2 are positive integers respectively, the L1 is a positive integer

greater than or equal to the Q1; the first channel information corresponds to Q antenna ports; the Q antenna ports consist of the Q1 antenna port(s) and the Q2 antenna port(s), the Q is equal to a sum of the Q1 and the Q2; the first reference signal is transmitted in a first time resources pool, and the second reference signal is transmitted in a second time resources pool, the first reference signal occurs multiple times in the first time resources pool, and time intervals between any two adjacent occurrences of the first reference signal in the first time resources pool are equal, the second reference signal occurs once in the second time resources pool.

170. For example, Defendant has and continues to directly infringe at least claim 11 of the ’727 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards such as the Accused Products (e.g., 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware for implementing 3rd Generation Partnership Product (3GPP) specifications).

171. For example, the Accused Products are each a UE comprising a first receiver receiving a first signaling, a second signaling, a first reference signal and a second reference signal. For example, the Accused Products include a first receiver that receives a first signaling (*e.g.*, CSI-ReportConfig IE, CSI-ResourceConfig IE, CSI-AperiodicTriggerStateList, CSI-SemiPersistentOnPUSCH-TriggerStateList) from the higher layer (*i.e.*, through RRC Configuration). The CSI-SemiPersistentOnPUSCH-TriggerStateList IE provides UE a set of a first reference signal(s) (*i.e.*, Periodic/Semi-persistent CSI RS resources for Channel) through CSI-ReportConfigID. In addition to the above first signaling, the Accused Products receive second signaling (*e.g.*, DCI format 0_1) from the downlink control information (DCI) (*i.e.*, through physical layer signaling). Upon successful decoding of DCI format 0_1 aperiodic CSI report is triggered and CSI-AperiodicTriggerStateList provides UE a set of a second reference signal(s)

(*i.e.*, Aperiodic CSI RS resources for Channel) through associated CSI-ReportConfigID.

### 5.2.1 Channel state information framework

The time and frequency resources that can be used by the UE to report CSI are controlled by the gNB. CSI may consist of Channel Quality Indicator (CQI), precoding matrix indicator (PMI), CSI-RS resource indicator (CRI), SS/PBCH Block Resource indicator (SSBRI), layer indicator (LI), rank indicator (RI) and/or L1-RSRP.

For CQI, PMI, CRI, SSBRI, LI, RI, L1-RSRP, a UE is configured by higher layers with N≥1 *CSI-ReportConfig* Reporting Settings, M≥1 *CSI-ResourceConfig* Resource Settings, and one or two list(s) of trigger states (given by the higher layer parameters *CSI-AperiodicTriggerStateList* and *CSI-SemiPersistentOnPUSCH-TriggerStateList*). Each trigger state in *CSI-AperiodicTriggerStateList* contains a list of associated *CSI-ReportConfigs* indicating the Resource Set IDs for channel and optionally for interference. Each trigger state in *CSI-SemiPersistentOnPUSCH-TriggerStateList* contains one associated *CSI-ReportConfig*. [53]

### 5.2.2.3 Reference signal (CSI-RS)

#### 5.2.2.3.1 NZP CSI-RS

The UE can be configured with one or more NZP CSI-RS resource set configuration(s) as indicated by the higher layer parameters *CSI-ResourceConfig*, and *NZP-CSI-RS-ResourceSet*. Each NZP CSI-RS resource set consists of *K*≥1 NZP CSI-RS resource(s).

The following parameters for which the UE shall assume non-zero transmission power for CSI-RS resource are configured via the higher layer parameter *NZP-CSI-RS-Resource* for each CSI-RS resource configuration:

- *nzp-CSI-RS-ResourceId* determines CSI-RS resource configuration identity.
- *periodicityAndOffset* defines the CSI-RS periodicity and slot offset for periodic/semi-persistent CSI-RS. All the CSI-RS resources within one set are configured with the same periodicity, while the slot offset can be same or different for different CSI-RS resources.
- *CSI-RS-resourceMapping* defines the number of ports, CDM-type, and OFDM symbol and subcarrier occupancy of the CSI-RS resource within a slot that are given in Subclause 7.4.1.5 of [4, TS 38.211].
- *nrofPorts* in *CSI-RS-ResourceMapping* defines the number of CSI-RS ports, where the allowable values are given in Subclause 7.4.1.5 of [4, TS 38.211]. [54]

### 7.4.1.5 CSI reference signals

#### 7.4.1.5.1 General

Zero-power (ZP) and non-zero-power (NZP) CSI-RS are defined

- for a non-zero-power CSI-RS configured by the *NZP-CSI-RS-Resource* IE or by the *CSI-RS-Resource-Mobility* field in the *CSI-RS-ResourceConfigMobility* IE, the sequence shall be generated according to clause 7.4.1.5.2 and mapped to resource elements according to clause 7.4.1.5.3
- for a zero-power CSI-RS configured by the *ZP-CSI-RS-Resource* IE, the UE shall assume that the resource elements defined in clause 7.4.1.5.3 are not used for PDSCH transmission. The UE performs the same measurement/reception on channels/signals except PDSCH regardless of whether they collide with ZP CSI-RS or not. [55]

[53] TS 38.214 V15.3.0, Section 5.2.1
[54] TS 38.214 V15.3.0, Section 5.2.2
[55] TS 38.211 V15.3.0, Section 7.4.1

### 5.2.1.5.2 Semi-persistent CSI/Semi-persistent CSI-RS

For semi-persistent reporting on PUSCH, a set of trigger states are higher layer configured by *CSI-SemiPersistentOnPUSCH-TriggerStateList,* where the CSI request field in DCI scrambled with SP-CSI-RNTI activates one of the trigger states. For semi-persistent reporting on PUCCH, the PUCCH resource used for transmitting the CSI report are configured by *reportConfigType*. A UE is not expected to receive a DCI scrambled with SP-CSI-RNTI activating one semi-persistent CSI report with the same CSI-ReportConfigId as in a semi-persistent CSI report which is activated by a previously received DCI scrambled with SP-CSI-RNTI. [56]

– *CSI-SemiPersistentOnPUSCH-TriggerStateList*

The *CSI-SemiPersistentOnPUSCH-TriggerStateList* IE is used to configure the UE with list of trigger states for semi-persistent reporting of channel state information on L1. See also 38.214, section 5.2.

***CSI-SemiPersistentOnPUSCH-TriggerStateList* information element**

```
-- ASN1START
-- TAG-CSI-SEMIPERSISTENTONPUSCHTRIGGERSTATELIST-START

CSI-SemiPersistentOnPUSCH-TriggerStateList ::=  SEQUENCE(SIZE (1..maxNrOfSemiPersistentPUSCH-Triggers)) OF CSI-SemiPersistentOnPUSCH-TriggerState

CSI-SemiPersistentOnPUSCH-TriggerState ::=      SEQUENCE {
    associatedReportConfigInfo                      CSI-ReportConfigId,
    ...
}


-- TAG-CSI-SEMIPERSISTENTONPUSCHTRIGGERSTATELIST-STOP
-- ASN1STOP
```

[57]

– *CSI-ReportConfig*

The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent on PUSCH triggered by DCI received on the cell in which the CSI-ReportConfig is included (in this case, the cell on which the report is sent is determined by the received DCI). See 38.214, section 5.2.1.

***CSI-ReportConfig* information element**

```
-- ASN1START
-- TAG-CSI-REPORTCONFIG-START

CSI-ReportConfig ::=                SEQUENCE {
```

***ETSI***

[58]

```
reportConfigId                          CSI-ReportConfigId,
carrier                                 ServCellIndex                   OPTIONAL,   -- Need S
resourcesForChannelMeasurement          CSI-ResourceConfigId,
csi-IM-ResourcesForInterference         CSI-ResourceConfigId        OPTIONAL,   -- Need R
nzp-CSI-RS-ResourcesForInterference     CSI-ResourceConfigId        OPTIONAL,   -- Need R
reportConfigType                        CHOICE {
    periodic                                SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUCCH                   SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUSCH                   SEQUENCE {
        reportSlotConfig                        ENUMERATED {sl5, sl10, sl20, sl40, sl80, sl160, sl320},
        reportSlotOffsetList                SEQUENCE (SIZE (1.. maxNrofUL-Allocations)) OF INTEGER(0..32),
        p0alpha                                 P0-PUSCH-AlphaSetId
    },
    aperiodic                               SEQUENCE {
        reportSlotOffsetList                SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)
    }
},
```

[59]

[56] TS 38.214 V15.3.0, Section 5.2.1
[57] TS 38.331 V 15.3.0
[58] TS 38.331 V 15.3.0
[59] TS 38.331 V 15.3.0

***resourcesForChannelMeasurement***
Resources for channel measurement. csi-ResourceConfigId of a CSI-ResourceConfig included in the configuration of the serving cell indicated with the field "carrier" above. The CSI-ResourceConfig indicated here contains only NZP-CSI-RS resources and/or SSB resources. This CSI-ReportConfig is associated with the DL BWP indicated by bwp-Id in that CSI-ResourceConfig. [60]

## 5.2.3 CSI reporting using PUSCH

A UE shall perform aperiodic CSI reporting using PUSCH on serving cell c upon successful decoding of a DCI format 0_1 which triggers an aperiodic CSI trigger state. [61]

### 5.2.1.5.1 Aperiodic CSI Reporting/Aperiodic CSI-RS

For CSI-RS resource sets associated with Resource Settings configured with the higher layer parameter *resourceType* set to 'aperiodic', periodic', or semi-persistent', trigger states for Reporting Setting(s) (configured with the higher layer parameter *reportConfigType* set to 'aperiodic') and/or Resource Setting for channel and/or interference measurement on one or more component carriers are configured using the higher layer parameter *CSI-AperiodicTriggerStateList*. For aperiodic CSI report triggering, a single set of CSI triggering states are higher layer configured, wherein the CSI triggering states can be associated with any candidate DL BWP. A UE is not expected to receive more than one DCI with non-zero CSI request per slot. A UE is not expected to receive more than one aperiodic CSI report request for transmission in a given slot. A UE is not expected to be triggered with a CSI report for a non-active DL BWP. A trigger state is initiated using the *CSI request* field in DCI. [62]

## 5.2.3 CSI reporting using PUSCH

A UE shall perform aperiodic CSI reporting using PUSCH on serving cell c upon successful decoding of a DCI format 0_1 which triggers an aperiodic CSI trigger state. [63]

### 5.2.1.5.1 Aperiodic CSI Reporting/Aperiodic CSI-RS

For CSI-RS resource sets associated with Resource Settings configured with the higher layer parameter *resourceType* set to 'aperiodic', periodic', or semi-persistent', trigger states for Reporting Setting(s) (configured with the higher layer parameter *reportConfigType* set to 'aperiodic') and/or Resource Setting for channel and/or interference measurement on one or more component carriers are configured using the higher layer parameter *CSI-AperiodicTriggerStateList*. For aperiodic CSI report triggering, a single set of CSI triggering states are higher layer configured, wherein the CSI triggering states can be associated with any candidate DL BWP. A UE is not expected to receive more than one DCI with non-zero CSI request per slot. A UE is not expected to receive more than one aperiodic CSI report request for transmission in a given slot. A UE is not expected to be triggered with a CSI report for a non-active DL BWP. A trigger state is initiated using the *CSI request* field in DCI. [64]

[60] TS 38.331 V 15.3.0
[61] TS 38.214 V 15.3.0, Section 5.2.3
[62] TS 38.214 V. 15.3.0, Section 5.2.1
[63] TS 38.214 V. 15.3.0, Section 5.2.3
[64] TS 38.214 V15.3.0, Section 5.2.1

– *CSI-ReportConfig*

The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent on PUSCH triggered by DCI received on the cell in which the CSI-ReportConfig is included (in this case, the cell on which the report is sent is determined by the received DCI). See 38.214, section 5.2.1.

***CSI-ReportConfig* information element**

```
-- ASN1START
-- TAG-CSI-REPORTCONFIG-START

CSI-ReportConfig ::=                SEQUENCE {
```

***ETSI***

[65]

```
reportConfigId                          CSI-ReportConfigId,
carrier                                 ServCellIndex                   OPTIONAL,   -- Need S
resourcesForChannelMeasurement          CSI-ResourceConfigId,
csi-IM-ResourcesForInterference         CSI-ResourceConfigId        OPTIONAL,   -- Need R
nzp-CSI-RS-ResourcesForInterference     CSI-ResourceConfigId        OPTIONAL,   -- Need R
reportConfigType                        CHOICE {
    periodic                                SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUCCH                   SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUSCH                   SEQUENCE {
        reportSlotConfig                        ENUMERATED {sl5, sl10, sl20, sl40, sl80, sl160, sl320},
        reportSlotOffsetList                SEQUENCE (SIZE (1.. maxNrofUL-Allocations)) OF INTEGER(0..32),
        p0alpha                                 P0-PUSCH-AlphaSetId
    },
    aperiodic                               SEQUENCE {
        reportSlotOffsetList                SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)
    }
},
```

[66]

***resourcesForChannelMeasurement***
Resources for channel measurement. csi-ResourceConfigId of a CSI-ResourceConfig included in the configuration of the serving cell indicated with the field "carrier" above. The CSI-ResourceConfig indicated here contains only NZP-CSI-RS resources and/or SSB resources. This CSI-ReportConfig is associated with the DL BWP indicated by bwp-Id in that CSI-ResourceConfig.

[67]

172. For example, the Accused Products comprise a first transmitter transmitting first channel information. For example, the Accused Products comprise a transmitter for transmitting first channel state information report (*i.e.*, channel information) either via the physical uplink control channel (PUCCH) for periodic/semi-persistent CSI reporting, or through the physical uplink shared channel (PUSCH) for aperiodic CSI reporting.

[65] TS 38.331 V15.3.0
[66] TS 38.331 V15.3.0
[67] TS 38.331 V15.3.0

### 5.2.1 Channel state information framework

The time and frequency resources that can be used by the UE to report CSI are controlled by the gNB. CSI may consist of Channel Quality Indicator (CQI), precoding matrix indicator (PMI), CSI-RS resource indicator (CRI), SS/PBCH Block Resource indicator (SSBRI), layer indicator (LI), rank indicator (RI) and/or L1-RSRP.

For CQI, PMI, CRI, SSBRI, LI, RI, L1-RSRP, a UE is configured by higher layers with N≥1 *CSI-ReportConfig* Reporting Settings, M≥1 *CSI-ResourceConfig* Resource Settings, and one or two list(s) of trigger states (given by the higher layer parameters *CSI-AperiodicTriggerStateList* and *CSI-SemiPersistentOnPUSCH-TriggerStateList*). Each trigger state in *CSI-AperiodicTriggerStateList* contains a list of associated *CSI-ReportConfigs* indicating the Resource Set IDs for channel and optionally for interference. Each trigger state in *CSI-SemiPersistentOnPUSCH-TriggerStateList* contains one associated *CSI-ReportConfig*.

[68]

### 5.2.4 CSI reporting using PUCCH

A UE is semi-statically configured by higher layers to perform periodic CSI Reporting on the PUCCH. A UE can be configured by higher layers for multiple periodic CSI Reports corresponding to multiple higher layer configured CSI Reporting Settings, where the associated CSI Resource Settings are higher layer configured. Periodic CSI reporting on PUCCH formats 2, 3, 4 supports Type I CSI with wideband granularity.

A UE shall perform semi-persistent CSI reporting on the PUCCH applied starting from slot $n + 3N_{slot}^{subframe,\mu} + 1$ after the HARQ-ACK corresponding to the PDSCH carrying the selection command [10, TS 38.321] is transmitted in slot *n*. The selection command will contain one or more Reporting Settings where the associated CSI Resource Settings are configured. Semi-persistent CSI reporting on the PUCCH supports Type I CSI. Semi-persistent CSI reporting on the PUCCH format 2 supports Type I CSI with wideband frequency granularity. Semi-persistent CSI reporting on PUCCH formats 3 or 4 supports Type I CSI with wideband and sub-band frequency granularities and Type II CSI Part 1.

[69]

### 5.2.3 CSI reporting using PUSCH

A UE shall perform aperiodic CSI reporting using PUSCH on serving cell c upon successful decoding of a DCI format 0_1 which triggers an aperiodic CSI trigger state.

[70]

173. For example, the Accused Products are UEs wherein the first reference signal comprises Q1 reference signal port(s), the Q1 reference signal port(s) is(are) transmitted by Q1 antenna port(s) respectively; the second reference signal comprises Q2 reference signal port(s), the Q2 reference signal port(s) is(are) transmitted by Q2 antenna port(s) respectively; the first signaling is used to determine L1 antenna port(s), the Q1 antenna port(s) is(are) a subset of the L1 antenna port(s); the second signaling is used to determine the Q2 antenna port(s); wherein the Q1

[68] TS 38.214 V15.3.0
[69] *Id.*
[70] *Id.*

and the Q2 are positive integers respectively, the L1 is a positive integer greater than or equal to the Q1; the first channel information corresponds to Q antenna ports; the Q antenna ports consist of the Q1 antenna port(s) and the Q2 antenna port(s), the Q is equal to a sum of the Q1 and the Q2. For example, Defendant and the Accused Products practice wherein the first reference signal (i.e., Periodic/Semi-persistent CSI RS resources for Channel) indicated by respective CSI-ResourceConfigID, provided using CSI-SemiPersistentOnPUSCH-TriggerStateList IE, contains a number of CSI resources (*i.e.*, Q1 reference signal port(s)) corresponding to a number of antenna ports (*i.e.*, transmitted by Q1 antenna port(s)). On the other hand, second reference signal (*i.e.*, aperiodic CSI RS resources for Channel) indicated by respective CSI-ResourceConfigID, provided using CSI-AperiodicTriggerStateList IE, contains a number of CSI resources (i.e., Q2 reference signal port(s)) corresponding to a number of antenna ports (*i.e.*, transmitted by Q2 antenna port(s)), wherein the number of CSI resources indicated in each CSI-RS-ResourceConfig set is more than or equal to the one (*i.e.*, Q1 and Q2 are positive integers respectively). In addition, Defendant and the Accused Products practice wherein a nrofPorts filed corresponding to CSI-RS-ResourceConfig set configured using CSI-SemiPersistentOnPUSCH-TriggerStateList IE and provided by CSI-RS-ResourceMapping (*i.e.*, first signaling) are used to determine the mapped QCLed antenna ports from which the periodic/semi-persistent CSI-RS resources are transmitted and used to determine the L1 characteristics such as L1-RSRP (*i.e.*, determine L1 antenna port(s), the Q1 antenna port(s) is(are) a subset of the L1 antenna port(s)). Defendant and the Accused Products practice wherein a value corresponding to CSI Request provided by DCI format 0_1 (*i.e.*, second signaling) provides a set of CSI-RS-Resources configured using CSI-AperiodicTriggerStateList IE for CSI reporting. The nrofPorts filed corresponding to CSI-RS-ResourceConfig set configured using CSI-AperiodicTriggerStateList and provided by DCI format 0_1 (*i.e.*, second signaling) is used to

determine the mapped antenna port number (*i.e.*, Q2 antenna port(s)) from which the aperiodic CSI-RS resources are transmitted and used to determine the L1 characteristics, such as L1-RSRP.

***resourcesForChannelMeasurement***
Resources for channel measurement. csi-ResourceConfigId of a CSI-ResourceConfig included in the configuration of the serving cell indicated with the field "carrier" above. The CSI-ResourceConfig indicated here contains only NZP-CSI-RS resources and/or SSB resources. This CSI-ReportConfig is associated with the DL BWP indicated by bwp-Id in that CSI-ResourceConfig. [71]

– *NZP-CSI-RS-ResourceSet*

The IE *NZP-CSI-RS-ResourceSet* is a set of Non-Zero-Power (NZP) CSI-RS resources (their IDs) and set-specific parameters.

***NZP-CSI-RS-ResourceSet* information element**

```
-- ASN1START
-- TAG-NZP-CSI-RS-RESOURCESET-START
NZP-CSI-RS-ResourceSet ::=          SEQUENCE {
    nzp-CSI-ResourceSetId               NZP-CSI-RS-ResourceSetId,
    nzp-CSI-RS-Resources                SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerSet)) OF NZP-CSI-RS-ResourceId,
    repetition                          ENUMERATED { on, off }                                  OPTIONAL,   -- Need S
    aperiodicTriggeringOffset           INTEGER(0..4)                                           OPTIONAL,   -- Need S
    trs-Info                            ENUMERATED {true}                                       OPTIONAL,   -- Need R
    ...
}

-- TAG-NZP-CSI-RS-RESOURCESET-STOP
-- ASN1STOP
```

[72]

### 5.2.1.2 Resource settings

Each Resource Setting *ResourceConfig* contains a configuration of S≥1 CSI-RS Resource Sets (higher layer parameter *ResourceSetConfig*), with each Resource Set consisting of CSI-RS resources (higher layer parameters *NZP-CSI-RS-ResourceConfigList* and *CSI-IM-ResourceConfigList)* and SS/PBCH Block resources used for L1-RSRP computation (higher layer parameter *resource-config-SS-list)*. Each Resource setting is located in the BWP identified by the higher layer parameter *BWP-info*, and all linked Resource Settings of a CSI Report Setting have the same BWP.

For periodic and semi-persistent CSI Resource Settings, S=1. Each set *s* contains $K_s \geq 1$ CSI-RS resources (higher layer parameter *CSI-RS-ResourceConfig*) each of which includes at least mapping to REs, number of ports and time-domain behavior as described in Subclause 5.2.2.3.1. The allowable antenna port values and resource mapping patterns are given in Subclause 7.4.1.5 of [4, TS 38.211]. The time domain behavior of the CSI-RS resources which are part of sets within a CSI-RS Resource Setting are indicated by the higher layer parameter *ResourceConfigType* and can be aperiodic, periodic, or semi-persistent. [73]

**Source:** TS 138 214 - V15.3.0 - 5G; NR; Physical layer procedures for data (3GPP TS 38.214 version 15.3.0 Release 15) (etsi.org), Page 35.

### 5.2.1.5.2 Semi-persistent CSI/Semi-persistent CSI-RS

For semi-persistent reporting on PUSCH, a set of trigger states are higher layer configured by *CSI-SemiPersistentOnPUSCH-TriggerStateList,* where the CSI request field in DCI scrambled with SP-CSI-RNTI activates one of the trigger states. For semi-persistent reporting on PUCCH, the PUCCH resource used for transmitting the CSI report are configured by *reportConfigType*. A UE is not expected to receive a DCI scrambled with SP-CSI-RNTI activating one semi-persistent CSI report with the same CSI-ReportConfigId as in a semi-persistent CSI report which is activated by a previously received DCI scrambled with SP-CSI-RNTI. [74]

[71] TS 38.331 V15.3.0
[72] *Id.*
[73] TS 38.214 V15.3.0
[74] *Id.*

## 5.2.4 CSI reporting using PUCCH

A UE is semi-statically configured by higher layers to perform periodic CSI Reporting on the PUCCH. A UE can be configured by higher layers for multiple periodic CSI Reports corresponding to multiple higher layer configured CSI Reporting Settings, where the associated CSI Resource Settings are higher layer configured. Periodic CSI reporting on PUCCH formats 2, 3, 4 supports Type I CSI with wideband granularity.

A UE shall perform semi-persistent CSI reporting on the PUCCH applied starting from slot $n + 3N_{slot}^{subframe,\mu} + 1$ after the HARQ-ACK corresponding to the PDSCH carrying the selection command [10, TS 38.321] is transmitted in slot *n*. The selection command will contain one or more Reporting Settings where the associated CSI Resource Settings are configured. Semi-persistent CSI reporting on the PUCCH supports Type I CSI. Semi-persistent CSI reporting on the PUCCH format 2 supports Type I CSI with wideband frequency granularity. Semi-persistent CSI reporting on PUCCH formats 3 or 4 supports Type I CSI with wideband and sub-band frequency granularities and Type II CSI Part 1. [75]

| ***CSI-RS-ResourceMapping field descriptions*** |
|---|
| ***cdm-Type***<br>CDM type (see 38.214, section 5.2.2.3.1) |
| ***density***<br>Density of CSI-RS resource measured in RE/port/PRB. Corresponds to L1 parameter 'CSI-RS-Density' (see 38.211, section 7.4.1.5.3).<br>Values 0.5 (*dot5*), 1 (one) and 3 (three) are allowed for X=1, values 0.5 (*dot5*) and 1 (one) are allowed for X=2, 16, 24 and 32, value 1 (one) is allowed for X=4, 8, 12.<br>For density = 1/2, includes 1-bit indication for RB level comb offset indicating whether odd or even RBs are occupied by CSI-RS. |
| ***firstOFDMSymbolInTimeDomain2***<br>Time domain allocation within a physical resource block. Parameter l1 in 38.211, section 7.4.1.5.3. |
| ***firstOFDMSymbolInTimeDomain***<br>Time domain allocation within a physical resource block. The field indicates the first OFDM symbol in the PRB used for CSI-RS. Parameter l0 in 38.211, section 7.4.1.5.3.<br>Value 2 is supported only when DL-DMRS-typeA-pos equals 3. |
| ***freqBand***<br>Wideband or partial band CSI-RS. Corresponds to L1 parameter 'CSI-RS-FreqBand' (see 38.214, section 5.2.2.3.1) |
| ***frequencyDomainAllocation***<br>Frequency domain allocation within a physical resource block in accordance with 38.211, section 7.4.1.5.3. The applicable row number in table 7.4.1.5.3-1 is determined by the frequencyDomainAllocation for rows 1, 2 and 4, and for other rows by matching the values in the column Ports, Density and CDMtype in table 7.4.1.5.3-1 with the values of nrofPorts, cdm-Type and density below and, when more than one row has the 3 values matching, by selecting the row where the column (k bar, l bar) in table 7.4.1.5.3-1 has indexes for k ranging from 0 to 2*n-1 where n is the number of bits set to 1 in frequencyDomainAllocation. |
| ***nrofPorts***<br>Number of ports (see 38.214, section 5.2.2.3.1) |

[76]

## 5.2.3 CSI reporting using PUSCH

A UE shall perform aperiodic CSI reporting using PUSCH on serving cell c upon successful decoding of a DCI format 0_1 which triggers an aperiodic CSI trigger state.

[77]

[75] *Id.*
[76] TS 38.331 V15.3.0
[77] *Id.*

#### 5.2.1.5.1 Aperiodic CSI Reporting/Aperiodic CSI-RS

For CSI-RS resource sets associated with Resource Settings configured with the higher layer parameter *resourceType* set to 'aperiodic', periodic', or semi-persistent', trigger states for Reporting Setting(s) (configured with the higher layer parameter *reportConfigType* set to 'aperiodic') and/or Resource Setting for channel and/or interference measurement on one or more component carriers are configured using the higher layer parameter *CSI-AperiodicTriggerStateList*. For aperiodic CSI report triggering, a single set of CSI triggering states are higher layer configured, wherein the CSI triggering states can be associated with any candidate DL BWP. A UE is not expected to receive more than one DCI with non-zero CSI request per slot. A UE is not expected to receive more than one aperiodic CSI report request for transmission in a given slot. A UE is not expected to be triggered with a CSI report for a non-active DL BWP. A trigger state is initiated using the *CSI request* field in DCI.

- When all the bits of *CSI request* field in DCI are set to zero, no CSI is requested.
- When the number of configured CSI triggering states in *CSI-AperiodicTriggerStateList* is greater than $2^{N_{TS}}-1$, where $N_{TS}$ is the number of bits in the DCI *CSI request* field, the UE receives a selection command [10, TS 38.321] used to map up to $2^{N_{TS}}-1$ trigger states to the codepoints of the *CSI request* field in DCI. $N_{TS}$ is configured by the higher layer parameter *reportTriggerSize* where $N_{TS} \in \{0,1,2,3,4,5,6\}$. When the HARQ/ACK corresponding to the PDSCH carrying the selection command is transmitted in the slot *n*, the corresponding action in [10, TS 38.321] and UE assumption on the mapping of the selected CSI trigger state(s) to the codepoint(s) of DCI CSI request field shall be applied starting from slot $n + 3N_{slot}^{subframe,\mu} + 1$.
- When the number of CSI triggering states in *CSI-AperiodicTriggerStateList* is less than or equal to $2^{N_{TS}}-1$, the *CSI request* field in DCI directly indicates the triggering state and the UE's quasi co-location assumption.

[78]

- CSI request – 0, 1, 2, 3, 4, 5, or 6 bits determined by higher layer parameter *reportTriggerSize*. [79]

The UE shall assume that a CSI-RS is transmitted using antenna ports $p$ numbered according to

$$p = 3000 + s + jL;$$
$$j = 0,1,\ldots,N/L-1$$
$$s = 0,1,\ldots,L-1;$$

[80]

#### 5.1.6.1 CSI-RS reception procedure

The CSI-RS defined in Subclause 7.4.1.5 of [4, TS 38.211], may be used for time/frequency tracking, CSI computation, L1-RSRP computation and mobility.

[81]

[78] TS 38.214 V15.3.0
[79] TS 38.212 V15.2.0
[80] TS 38.211 V15.3.0
[81] TS 38.214 V15.3.0

where $s$ is the sequence index provided by Tables 7.4.1.5.3-2 to 7.4.1.5.3-5, $L \in \{1,2,4,8\}$ is the CDM group size, and $N$ is the number of CSI-RS ports. The CDM group index $j$ given in Table 7.4.1.5.3-1 corresponds to the time/frequency locations $(\bar{k},\bar{l})$ for a given row of the table. The CDM groups are numbered in order of increasing frequency domain allocation first and then increasing time domain allocation. For a CSI-RS resource configured as periodic or semi-persistent by the higher-layer parameter *resourceType*, the UE shall assume that the CSI-RS is transmitted in slots satisfying

$$\left(N_{\text{slot}}^{\text{frame},\mu} n_{\text{f}} + n_{\text{s,f}}^{\mu} - T_{\text{offset}}\right) \bmod T_{\text{CSI-RS}} = 0$$

[82]

174. For example, Defendant and the Accused Products practice wherein the first channel state information report (*i.e.*, channel information) is transmitted via the physical uplink control channel (PUCCH) for periodic/semi-persistent CSI reporting (*i.e.*, for Q1 Antenna Ports), and through the physical uplink shared channel (PUSCH) for aperiodic CSI reporting (*i.e.*, for Q2 Antenna Ports). Therefore, the transmitted channel state information consists of the channel state information for Q1 antenna ports and Q2 antenna ports (*i.e.*, the first channel information corresponds to Q antenna ports; the Q antenna ports consist of the Q1 antenna port(s) and the Q2 antenna port(s), the Q is equal to a sum of the Q1 and the Q2;).

### 5.2.1 Channel state information framework

The time and frequency resources that can be used by the UE to report CSI are controlled by the gNB. CSI may consist of Channel Quality Indicator (CQI), precoding matrix indicator (PMI), CSI-RS resource indicator (CRI), SS/PBCH Block Resource indicator (SSBRI), layer indicator (LI), rank indicator (RI) and/or L1-RSRP.

For CQI, PMI, CRI, SSBRI, LI, RI, L1-RSRP, a UE is configured by higher layers with N≥1 *CSI-ReportConfig* Reporting Settings, M≥1 *CSI-ResourceConfig* Resource Settings, and one or two list(s) of trigger states (given by the higher layer parameters *CSI-AperiodicTriggerStateList* and *CSI-SemiPersistentOnPUSCH-TriggerStateList*). Each trigger state in *CSI-AperiodicTriggerStateList* contains a list of associated *CSI-ReportConfigs* indicating the Resource Set IDs for channel and optionally for interference. Each trigger state in *CSI-SemiPersistentOnPUSCH-TriggerStateList* contains one associated *CSI-ReportConfig*.

[83]

[82] TS 38.211 V15.3.0
[83] TS 38.214 V15.3.0

### 5.2.1.1 Reporting settings

Each Reporting Setting *CSI-ReportConfig* is associated with a single downlink BWP (indicated by higher layer parameter *bwp-Id*) given in the associated *CSI-ResourceConfig* for channel measurement and contains the parameter(s) for one CSI reporting band:codebook configuration including codebook subset restriction, time-domain behavior, frequency granularity for CQI and PMI, measurement restriction configurations, and the CSI-related quantities to be reported by the UE such as the layer indicator (LI), L1-RSRP, CRI, and SSBRI (SSB Resource Indicator).

The time domain behavior of the *CSI-ReportConfig* is indicated by the higher layer parameter *reportConfigType* and can be set to 'aperiodic', 'semiPersistentOnPUCCH', 'semiPersistentOnPUSCH', or 'periodic'. For periodic and semiPersistentOnPUCCH/semiPersistentOnPUSCH CSI reporting, the configured periodicity and slot offset applies in the numerology of the UL BWP in which the CSI report is configured to be transmitted on. The higher layer parameter *reportQuantity* indicates the CSI-related or L1-RSRP-related quantities to report. The *reportFreqConfiguration* indicates the reporting granularity in the frequency domain, including the CSI reporting band and if PMI/CQI reporting is wideband or sub-band. The *timeRestrictionForChannelMeasurements* parameter in *CSI-ReportConfig* can be configured to enable time domain restriction for channel measurements and *timeRestrictionForInterferenceMeasurements* can be configured to enable time domain restriction for interference measurements. The *CSI-ReportConfig* can also contain *CodebookConfig*, which contains configuration parameters for Type-I or Type II CSI including codebook subset restriction, and configurations of group based reporting. [84]

– *CSI-ReportConfig*

The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent on PUSCH triggered by DCI received on the cell in which the CSI-ReportConfig is included (in this case, the cell on which the report is sent is determined by the received DCI). See 38.214, section 5.2.1.

***CSI-ReportConfig* information element**

```
-- ASN1START
-- TAG-CSI-REPORTCONFIG-START

CSI-ReportConfig ::=                SEQUENCE {
```

***ETSI*** [85]

```
reportConfigId                          CSI-ReportConfigId,
carrier                                 ServCellIndex                   OPTIONAL,   -- Need S
resourcesForChannelMeasurement          CSI-ResourceConfigId,
csi-IM-ResourcesForInterference         CSI-ResourceConfigId        OPTIONAL,   -- Need R
nzp-CSI-RS-ResourcesForInterference     CSI-ResourceConfigId        OPTIONAL,   -- Need R
reportConfigType                        CHOICE {
    periodic                                SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUCCH                   SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUSCH                   SEQUENCE {
        reportSlotConfig                        ENUMERATED (sl5, sl10, sl20, sl40, sl80, sl160, sl320),
        reportSlotOffsetList                SEQUENCE (SIZE (1.. maxNrofUL-Allocations)) OF INTEGER(0..32),
        p0alpha                                 P0-PUSCH-AlphaSetId
    },
    aperiodic                               SEQUENCE {
        reportSlotOffsetList                SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)
    }
},
```

[86]

175. For example the Accused Products comprise a UE where the first reference signal is transmitted in a first time resources pool, and the second reference signal is transmitted in a

[84] *Id.*
[85] TS 38.331 V15.3.0
[86] *Id.*

second time resources pool, the first reference signal occurs multiple times in the first time resources pool, and time intervals between any two adjacent occurrences of the first reference signal in the first time resources pool are equal, the second reference signal occurs once in the second time resources pool. For example, the Accused Products receive a set of a first reference signal(s) (*i.e.*, Periodic/Semi-persistent CSI RS resources for Channel) in one set (*i.e.*, in a first time resources pool) and second reference signal(s) (i.e., aperiodic CSI RS resources for Channel) in second set (*i.e.*, in a second time resources pool). In addition, it is also mentioned that the first reference signal(s) (*i.e.*, Periodic/Semi-persistent CSI RS resources for Channel) is present either two or four times in a slot (*i.e.*, the first reference signal occurs multiple times in the first time resources pool) and their time domain location between two slots remain same (*i.e.*, and time intervals between any two adjacent occurrences of the first reference signal in the first time resources pool are equal). The second reference signal(s) received in the second resource set (*i.e.*, aperiodic CSI RS resources for Channel) in second set (*i.e.*, in a second time resources pool) is aperiodic and instantly triggered by DCI format 0_1 (*i.e.*, the second reference signal occurs once in the second time resources pool).

> A UE configured with *NZP-CSI-RS-ResourceSet(s)* configured with higher layer parameter *trs-Info* may have the CSI-RS resources configured as:
>
> - Periodic, with the CSI-RS resources in the *NZP-CSI-RS-ResourceSet* configured with same periodicity, bandwidth and subcarrier location
>
> - Periodic CSI-RS resource in one set and aperiodic CSI-RS resources in a second set, with the aperiodic CSI-RS and periodic CSI-RS resource having the same bandwidth (with same RB location)and the aperiodic CSI-RS being 'QCL-Type-A' and 'QCL-TypeD', where applicable, with the periodic CSI-RS resources. For frequency range 2, the UE does not expect that the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources is smaller than the UE reported *ThresholdSched-Offset*. The UE shall expect that the periodic CSI-RS resource set and aperiodic CSI-RS resource set are configured with the same number of CSI-RS resources. For the aperiodic CSI-RS resource set if triggered, and if the associated periodic CSI-RS resource set is configured with four periodic CSI-RS resources with two consecutive slots with two periodic CSI-RS resources in each slot, the higher layer parameter *aperiodicTriggeringOffset* indicates the triggering offset for the first slot for the first two CSI-RS resources in the set.

[87]

[87] TS 38.214 V15.3.0

- the time-domain locations of the two periodic CSI-RS resources in a slot, or of the four periodic CSI-RS resources in two consecutive slots (which are the same across two consecutive slots), as defined by higher layer parameter *CSI-RS-resourceMapping*, is given by one of
  - $l \in \{4,8\}$, $l \in \{5,9\}$, or $l \in \{6,10\}$ for frequency range 1 and frequency range 2,
  - $l \in \{0,4\}$, $l \in \{1,5\}$, $l \in \{2,6\}$, $l \in \{3,7\}$, $l \in \{7,11\}$, $l \in \{8,12\}$ or $l \in \{9,13\}$ for frequency range 2.[88]

176. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '727 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant's customers and end-users, in this District and elsewhere in the United States. For example, Defendant's customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the '727 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[89] Because of Defendant's inducement, Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '727 Patent. Defendant performs these affirmative acts with knowledge of the '727 Patent and with the intent, or willful blindness, that the induced acts directly infringe the '727 Patent.

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[88] *Id.*

[89] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

177. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’727 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant’s affirmative acts of selling and offering to sell the Accused Products in this District and elsewhere in the United States and causing the Accused Products to be manufactured, used, sold, and offered for sale contribute to others’ use and manufacture of the Accused Products such that the ’727 Patent is directly infringed by others. The accused components within the Accused Products including, but not limited to, chipsets manufactured by Defendant, are material to the invention of the ’727 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the ’727 Patent. Defendant performs these affirmative acts with knowledge of the ’727 Patent and with intent, or willful blindness, that they cause the direct infringement of the ’727 Patent.

178. ABT has suffered damages as a result of Defendant’s direct and indirect infringement of the ’727 Patent in an amount to be proved at trial.

179. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant’s infringement of the ’727 Patent, for which there is no adequate remedy at law, unless Defendant’s infringement is enjoined by this Court.

180. On information and belief, Defendant acted egregiously and with willful misconduct in that their actions constituted direct or indirect infringement of a valid patent, and this was either known or so obvious that Defendant should have known about it. Defendant continue to infringe the ’727 Patent by making, using, selling, offering for sale, and/or importing in the United States the Accused Products and by inducing the direct infringing use, sale, offer for

sale, and importation of the Accused Products by others, in reckless disregard of ABT's patent rights. Defendant has committed and continue to commit acts of infringement that Defendant actually knew or should have known constituted an unjustifiably high risk of infringement of at least one valid and enforceable claim of the '727 Patent. Upon information and belief, Defendant had actual knowledge of the '727 Patent from related prior litigations accusing either the same products involving Defendant and products with similar 5G functionalities involving direct competitors of Defendant. Defendant's infringement of the '727 Patent has been and continues to be willful, entitling ABT to an award of treble damages, reasonable attorney fees, and costs in bringing this action under 35 U.S.C. §§ 284 and 285.

**COUNT IX**
**(Infringement of the '721 Patent)**

181. The preceding paragraphs are incorporated by reference as if fully set forth herein.

182. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the '721 Patent.

183. Defendant has and continues to directly infringe the '721 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '721 Patent. Such products include at least Accused Products including, but not limited to, Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which

are user equipment for wireless communication, comprising: a first processor transmitting a first wireless signal; and a first transmitter transmitting a second wireless signal; wherein the first wireless signal is generated by a first sequence; the first wireless signal is used to determine a first time interval; the first time interval is a time interval between a first time instant and a second time instant; the first time instant is a starting time instant at which a transmitter of the first wireless signal transmits the first wireless signal; the second time instant is a starting time instant at which a transmitter of the second wireless signal transmits the second wireless signal; the first time instant is earlier than the second time instant; the second wireless signal occupies a first wireless resource; the first wireless resource is one of J candidate wireless resources; the J is a positive integer; the first time interval is used to determine the first wireless resource out of the J candidate wireless resources; the first sequence is a Zadoff-Chu (ZC) sequence, a transport channel corresponding to the first wireless signal is a Random Access Channel (RACH), a physical channel corresponding to the second wireless signal is a Physical Uplink Shared Channel (PUSCH); the first wireless signal is used to determine whether the second wireless signal is transmitted or not.

184. For example, Defendant has and continues to directly infringe at least claim 11 of the ’721 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards such as the Accused Products (*e.g.*, 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware for implementing 3rd Generation Partnership Product (3GPP) specifications).

185. For example, the Accused Products comprise a first processor transmitting a first wireless signal. For example, the “first wireless signal” may additionally be “Msg1” OR “Random Access Preamble” and can be transmitted on PRACH (first channel) on a PRACH occasion as specified in section 5.1.1 TS 38.321 v16.1.0.

### 5.1.1 Random Access procedure initialization

The Random Access procedure described in this clause is initiated by a PDCCH order, by the MAC entity itself, or by RRC for the events in accordance with TS 38.300 [2]. There is only one Random Access procedure ongoing at any point in time in a MAC entity. The Random Access procedure on an SCell shall only be initiated by a PDCCH order with *ra-PreambleIndex* different from 0b000000.

NOTE 1: If a new Random Access procedure is triggered while another is already ongoing in the MAC entity, it is up to UE implementation whether to continue with the ongoing procedure or start with the new procedure (e.g. for SI request).

NOTE 2: If there was an ongoing Random Access procedure that is triggered by a PDCCH order while the UE receives another PDCCH order indicating the same Random Access Preamble, PRACH mask index and uplink carrier, the Random Access procedure is considered as the same Random Access procedure as the ongoing one and not initialized again.

When a Random Access procedure is initiated, UE selects a set of Random Access resources as specified in clause 5.1.1b and initialises the following parameters for the Random Access procedure according to the values configured by RRC for the selected set of Random Access resources:

- *prach-ConfigurationIndex*: the available set of PRACH occasions for the transmission of the Random Access Preamble for Msg1. These are also applicable to the MSGA PRACH if the PRACH occasions are shared between 2-step and 4-step RA types;

[90]

186. For example, the Accused Products comprise a first transmitter transmitting a second wireless signal. For example, the Accused Products are configured to transmit a second wireless signal (*e.g.*, Msg3) on a second channel (*e.g.*, PUSCH scheduled by a RAR UL grant).

## 8 Random access procedure

Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements.

Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in clauses 8.1 through 8.4, or a Type-2 random access procedure as described in clauses 8.1 through 8.2A.

Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers:

- Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission).
- Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift ( $N_{CS}$ ), and set type (unrestricted, restricted set A, or restricted set B)).

From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution. [91]

[90] TS38.321 V17.0.0
[91] TS38.213 V17.1.0

187. For example, the Accused Products are user equipment, wherein the first wireless signal is generated by a first sequence. For example, the Accused Products are configured to generate a first wireless signal (*e.g.*, Random Access Preamble for Msg1) on a first channel (*e.g.,* PRACH). The UE selects a random-access preamble from a set of predefined preambles. These preambles can be of roughly two categories: Short Preamble and Long Preamble Format. The UE also selects a random sequence number for the preamble. After choosing the preamble and sequence number, the UE transmits the preamble on the PRACH.

### 6.3.3 Physical random-access channel

#### 6.3.3.1 Sequence generation

The set of random-access preambles $x_{u,v}(n)$ shall be generated according to

$$x_{u,v}(n) = x_u((n + C_v) \bmod L_{\mathrm{RA}})$$

$$x_u(i) = e^{-j\frac{\pi u i(i+1)}{L_{\mathrm{RA}}}}, i = 0,1,\ldots,L_{\mathrm{RA}} - 1$$

from which the frequency-domain representation shall be generated according to

$$y_{u,v}(n) = \sum_{m=0}^{L_{\mathrm{RA}}-1} x_{u,v}(m) \cdot e^{-j\frac{2\pi mn}{L_{\mathrm{RA}}}}$$

where $L_{\mathrm{RA}} = 839$, $L_{\mathrm{RA}} = 139$, $L_{\mathrm{RA}} = 1151$, or $L_{\mathrm{RA}} = 571$ depending on the PRACH preamble format as given by Tables 6.3.3.1-1 and 6.3.3.1-2.

There are 64 preambles defined in each time-frequency PRACH occasion, enumerated in increasing order of first increasing cyclic shift $C_v$ of a logical root sequence, and then in increasing order of the logical root sequence index, starting with the index obtained from the higher-layer parameter *prach-RootSequenceIndex* or *rootSequenceIndex-BFR* or by *msgA-PRACH-RootSequenceIndex* if configured and a type-2 random-access procedure is initiated as described in clause 8.1 of [5, TS 38.213]. Additional preamble sequences, in case 64 preambles cannot be generated from a single root Zadoff-Chu sequence, are obtained from the root sequences with the consecutive logical indexes until all the 64 sequences are found. The logical root sequence order is cyclic; the logical index 0 is consecutive to $L_{\mathrm{RA}} - 2$. The sequence number $u$ is obtained from the logical root sequence index according to Tables 6.3.3.1-3 to 6.3.3.1-4B. [92]

188. For example, the Accused Products are user equipment, wherein the first wireless signal is used to determine a first time interval; the first time interval is a time interval between a first time instant and a second time instant. For example, the Accused Products are configured to transmit a first wireless signal (*e.g.*, Random Access Preamble for Msg1) on a first channel (*e.g.,*

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PRACH) on a PRACH occasion (*i.e.*, first-time instant). The Random Access procedure is used by user equipment (UE), such as a mobile device, to initiate communication with the network. Msg1 corresponds to the first message sent by the UE during this procedure. Msg1 helps the network to identify the UE and establish initial synchronization. The network uses the information from Msg1, such as the Random Access preamble, to identify the UE and estimate the initial timing adjustments. Once the gNB receives Msg1, it allocates resources for the UE to continue the communication. The network responds with a Random Access Response (Msg2), providing information to the UE for further communication, including a temporary identifier and scheduling information. After successful completion of the procedure, the UE can proceed with additional signalling for connection establishment, registration, and data transfer and transmission of PUSCH (Msg 3). The time slot at which PUSCH is sent by the UE is considered the *second time instant*. The PUSCH is transmitted on different slots (*i.e.*, determining the first time interval when the PUSCH should be transmitted). The actual separation depends on the subcarrier spacing (SCS) configuration for the active uplink bandwidth part (UL BWP) and the type of repetition for PUSCH transmission.

## 8 Random access procedure

Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements.

Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in clauses 8.1 through 8.4, or a Type-2 random access procedure as described in clauses 8.1 through 8.2A.

Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers:

- Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission).
- Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift ( $N_{CS}$ ), and set type (unrestricted, restricted set A, or restricted set B)).

From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution. [93]

## 8.1 Random access preamble

Physical random access procedure is triggered upon request of a PRACH transmission by higher layers or by a PDCCH order. A configuration by higher layers for a PRACH transmission includes the following:

- A configuration for PRACH transmission [4, TS 38.211].
- A preamble index, a preamble SCS, $P_{\mathrm{PRACH,target}}$, a corresponding RA-RNTI, and a PRACH resource.

A PRACH is transmitted using the selected PRACH format with transmission power $P_{\mathrm{PRACH},b,f,c}(i)$, as described in clause 7.4, on the indicated PRACH resource.

For Type-1 random access procedure, a UE is provided a number $N$ of SS/PBCH block indexes associated with one PRACH occasion and a number $R$ of contention based preambles per SS/PBCH block index per valid PRACH occasion by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*.

…..

For Type-1 random access procedure, or for Type-2 random access procedure with separate configuration of PRACH occasions from Type 1 random access procedure, if $N < 1$, one SS/PBCH block index is mapped to $1/N$ consecutive valid PRACH occasions and $R$ contention based preambles with consecutive indexes associated with the SS/PBCH block index per valid PRACH occasion start from preamble index 0. If $N \geq 1$, $R$ contention based preambles with consecutive indexes associated with SS/PBCH block index $n$, $0 \leq n \leq N-1$, per valid PRACH occasion start from preamble index $n \cdot N_{\mathrm{preamble}}^{\mathrm{total}}/N$ where $N_{\mathrm{preamble}}^{\mathrm{total}}$ is provided by *totalNumberOfRA-Preambles* for Type-1 random access procedure, or by *msgA-TotalNumberOfRA-Preambles* for Type-2 random access procedure with separate configuration of PRACH occasions from a Type 1 random access procedure, and is an integer multiple of $N$.

….

For a PRACH transmission triggered by higher layers, if *ssb-ResourceList* is provided, the PRACH mask index is indicated by *ra-ssb-OccasionMaskIndex* which indicates the PRACH occasions for the PRACH transmission where the PRACH occasions are associated with the selected SS/PBCH block index.

The PRACH occasions are mapped consecutively per corresponding SS/PBCH block index. The indexing of the PRACH occasion indicated by the mask index value is reset per mapping cycle of consecutive PRACH occasions per SS/PBCH block index. The UE selects for a PRACH transmission the PRACH occasion indicated by PRACH mask index value for the indicated SS/PBCH block index in the first available mapping cycle.

For the indicated preamble index, the ordering of the PRACH occasions is

- First, in increasing order of frequency resource indexes for frequency multiplexed PRACH occasions
- Second, in increasing order of time resource indexes for time multiplexed PRACH occasions within a PRACH slot

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- Third, in increasing order of indexes for PRACH slots

For a PRACH transmission triggered upon request by higher layers, a value of *ra-OccasionList* [12, TS 38.331], if *csirs-ResourceList* is provided, indicates a list of PRACH occasions for the PRACH transmission where the PRACH occasions are associated with the selected CSI-RS index indicated by *csi-RS*. The indexing of the PRACH occasions indicated by *ra-OccasionList* is reset per association pattern period.

**Table 8.1-1: Mapping between PRACH configuration period and SS/PBCH block to PRACH occasion association period**

| PRACH configuration period (msec) | Association period (number of PRACH configuration periods) |
|---|---|
| 10 | {1, 2, 4, 8, 16} |
| 20 | {1, 2, 4, 8} |
| 40 | {1, 2, 4} |
| 80 | {1, 2} |
| 160 | {1} |

….

For a PRACH transmission using 1.25 kHz or 5 kHz SCS, the UE determines $N_2$ assuming SCS configuration $\mu = 0$.

For single cell operation or for operation with carrier aggregation in a same frequency band, a UE does not transmit PRACH and PUSCH/PUCCH/SRS in a same slot or when a gap between the first or last symbol of a PRACH transmission in a first slot is separated by less than $N$ symbols from the last or first symbol, respectively, of a PUSCH/PUCCH/SRS transmission in a second slot where $N = 2$ for $\mu = 0$ or $\mu = 1$, $N = 4$ for $\mu = 2$ or $\mu = 3$, $N = 16$ for $\mu = 5$, $N = 32$ for $\mu = 6$, and $\mu$ is the SCS configuration for the active UL BWP. For a PUSCH transmission with repetition Type B, this applies to each actual repetition for PUSCH transmission [6, TS 38.214]. [94]

189. For example, the Accused Products are user equipment, wherein the first time instant is a starting time instant at which a transmitter of the first wireless signal transmits the first wireless signal; the second time instant is a starting time instant at which a transmitter of the second wireless signal transmits the second wireless signal; the actual separation depends on the subcarrier spacing (SCS) configuration for the active uplink bandwidth part (UL BWP) and the type of repetition for PUSCH transmission.

# 8 Random access procedure

Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements.

Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in clauses 8.1 through 8.4, or a Type-2 random access procedure as described in clauses 8.1 through 8.2A.

Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers:

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- Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission).
- Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift ( $N_{CS}$ ), and set type (unrestricted, restricted set A, or restricted set B)).

From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution. [95]

190. The actual separation depends on the subcarrier spacing (SCS) configuration for the active uplink bandwidth part (UL BWP) and the type of repetition for PUSCH transmission.

# 8 Random access procedure

Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements.

Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in clauses 8.1 through 8.4, or a Type-2 random access procedure as described in clauses 8.1 through 8.2A.

Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers:

- Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission).
- Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift ( $N_{CS}$ ), and set type (unrestricted, restricted set A, or restricted set B)).

From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution. [96]

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[96] TS38.213 V17.1.0

## 8.1 Random access preamble

Physical random access procedure is triggered upon request of a PRACH transmission by higher layers or by a PDCCH order. A configuration by higher layers for a PRACH transmission includes the following:

- A configuration for PRACH transmission [4, TS 38.211].
- A preamble index, a preamble SCS, $P_{\mathrm{PRACH,target}}$, a corresponding RA-RNTI, and a PRACH resource.

A PRACH is transmitted using the selected PRACH format with transmission power $P_{\mathrm{PRACH},b,f,c}(i)$, as described in clause 7.4, on the indicated PRACH resource.

For Type-1 random access procedure, a UE is provided a number $N$ of SS/PBCH block indexes associated with one PRACH occasion and a number $R$ of contention based preambles per SS/PBCH block index per valid PRACH occasion by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*.

…..

For Type-1 random access procedure, or for Type-2 random access procedure with separate configuration of PRACH occasions from Type 1 random access procedure, if $N < 1$, one SS/PBCH block index is mapped to $1/N$ consecutive valid PRACH occasions and $R$ contention based preambles with consecutive indexes associated with the SS/PBCH block index per valid PRACH occasion start from preamble index 0. If $N \geq 1$, $R$ contention based preambles with consecutive indexes associated with SS/PBCH block index $n$, $0 \leq n \leq N-1$, per valid PRACH occasion start from preamble index $n \cdot N_{\mathrm{preamble}}^{\mathrm{total}}/N$ where $N_{\mathrm{preamble}}^{\mathrm{total}}$ is provided by *totalNumberOfRA-Preambles* for Type-1 random access procedure, or by *msgA-TotalNumberOfRA-Preambles* for Type-2 random access procedure with separate configuration of PRACH occasions from a Type 1 random access procedure, and is an integer multiple of $N$.

….

For a PRACH transmission triggered by higher layers, if *ssb-ResourceList* is provided, the PRACH mask index is indicated by *ra-ssb-OccasionMaskIndex* which indicates the PRACH occasions for the PRACH transmission where the PRACH occasions are associated with the selected SS/PBCH block index.

The PRACH occasions are mapped consecutively per corresponding SS/PBCH block index. The indexing of the PRACH occasion indicated by the mask index value is reset per mapping cycle of consecutive PRACH occasions per SS/PBCH block index. The UE selects for a PRACH transmission the PRACH occasion indicated by PRACH mask index value for the indicated SS/PBCH block index in the first available mapping cycle.

For the indicated preamble index, the ordering of the PRACH occasions is

- First, in increasing order of frequency resource indexes for frequency multiplexed PRACH occasions
- Second, in increasing order of time resource indexes for time multiplexed PRACH occasions within a PRACH slot
- Third, in increasing order of indexes for PRACH slots

For a PRACH transmission triggered upon request by higher layers, a value of *ra-OccasionList* [12, TS 38.331], if *csirs-ResourceList* is provided, indicates a list of PRACH occasions for the PRACH transmission where the PRACH occasions are associated with the selected CSI-RS index indicated by *csi-RS*. The indexing of the PRACH occasions indicated by *ra-OccasionList* is reset per association pattern period.

**Table 8.1-1: Mapping between PRACH configuration period and SS/PBCH block to PRACH occasion association period**

| PRACH configuration period (msec) | Association period (number of PRACH configuration periods) |
|---|---|
| 10 | {1, 2, 4, 8, 16} |
| 20 | {1, 2, 4, 8} |
| 40 | {1, 2, 4} |
| 80 | {1, 2} |
| 160 | {1} |

….

For a PRACH transmission using 1.25 kHz or 5 kHz SCS, the UE determines $N_2$ assuming SCS configuration $\mu = 0$.

For single cell operation or for operation with carrier aggregation in a same frequency band, a UE does not transmit PRACH and PUSCH/PUCCH/SRS in a same slot or when a gap between the first or last symbol of a PRACH transmission in a first slot is separated by less than $N$ symbols from the last or first symbol, respectively, of a PUSCH/PUCCH/SRS transmission in a second slot where $N = 2$ for $\mu = 0$ or $\mu = 1$, $N = 4$ for $\mu = 2$ or $\mu = 3$, $N = 16$ for $\mu = 5$, $N = 32$ for $\mu = 6$, and $\mu$ is the SCS configuration for the active UL BWP. For a PUSCH transmission with repetition Type B, this applies to each actual repetition for PUSCH transmission [6, TS 38.214]. [97]

191. For example the Accused Products are user equipment wherein the first time instant is earlier than the second time instant. For example, the Accused Products are configured to transmit the PRACH using reserved parts of the uplink resource grid that are known as PRACH occasions (*i.e.*, first-time instant). After successful completion of the procedure, the UE can proceed with additional signalling for connection establishment, registration, and data transfer and

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transmission of PUSCH (Msg 3). The time slot at which PUSCH is sent by the UE is considered the *second time instant*. The PUSCH is transmitted on different slots (*i.e.*, the first time instant is earlier than the second time instant).

## 8.1 Random access preamble

…..

For a PRACH transmission using 1.25 kHz or 5 kHz SCS, the UE determines $N_2$ assuming SCS configuration $\mu = 0$.

For single cell operation or for operation with carrier aggregation in a same frequency band, a UE does not transmit PRACH and PUSCH/PUCCH/SRS in a same slot or when a gap between the first or last symbol of a PRACH transmission in a first slot is separated by less than $N$ symbols from the last or first symbol, respectively, of a PUSCH/PUCCH/SRS transmission in a second slot where $N = 2$ for $\mu = 0$ or $\mu = 1$, $N = 4$ for $\mu = 2$ or $\mu = 3$, $N = 16$ for $\mu = 5$, $N = 32$ for $\mu = 6$, and $\mu$ is the SCS configuration for the active UL BWP. For a PUSCH transmission with repetition Type B, this applies to each actual repetition for PUSCH transmission [6, TS 38.214]. [98]

192. For example the Accused Products are user equipment wherein the second wireless signal occupies a first wireless resource; the first wireless resource is one of J candidate wireless resources; the J is a positive integer; the first time interval is used to determine the first wireless resource out of the J candidate wireless resources. For example, the Accused Products begin the random access procedure by transmitting one or more preambles on the physical random access channel. A PRACH preamble has its own subcarrier spacing, which can be different from that of the other uplink channels, and which is the reciprocal of the PRACH symbol duration. There are two types of preambles. Long PRACH preambles occupy 839 subcarriers with a spacing of 1.25 or 5 kHz and are only used in frequency range 1 (FR1). Short PRACH preambles occupy 139 subcarriers, with a spacing of 15 or 30 kHz in FR1 and 60 or 120 kHz in FR2. Taken together, the preamble length and subcarrier spacing determine the bandwidth of the PRACH transmission. By combining that quantity with the PUSCH subcarrier spacing, the number of PUSCH resource blocks that it occupies can be calculated.

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### 6.3.3.2 Mapping to physical resources

The preamble sequence shall be mapped to physical resources according to

$$a_k^{(p,\mathrm{RA})} = \beta_{\mathrm{PRACH}} y_{u,v}(k)$$
$$k = 0,1,\ldots,L_{\mathrm{RA}} - 1$$

where $\beta_{\mathrm{PRACH}}$ is an amplitude scaling factor in order to conform to the transmit power specified in [5, TS38.213], and $p = 4000$ is the antenna port. Baseband signal generation shall be done according to clause 5.3 using the parameters in Table 6.3.3.1-1 or Table 6.3.3.1-2 with $\bar{k}$ given by Table 6.3.3.2-1.

Random access preambles can only be transmitted in the time resources obtained from Tables 6.3.3.2-2 to 6.3.3.2-4 and depends on FR1 or FR2 and the spectrum type as defined in [8, TS38.104]. The PRACH configuration index in Tables 6.3.3.2-2 to 6.3.3.2-4 is

[99]

**Table 6.3.3.2-2: Random access configurations for FR1 and paired spectrum/supplementary uplink.**

| PRACH Configuration Index | Preamble format | $n_f$ mod $x = y$ | | Subframe number | Starting symbol | Number of PRACH slots within a subframe | $N_t^{\mathrm{RA,slot}}$, number of time-domain PRACH occasions within a PRACH slot | $N_{\mathrm{dur}}^{\mathrm{RA}}$, PRACH duration |
|---|---|---|---|---|---|---|---|---|
| | | $x$ | $y$ | | | | | |
| 0 | 0 | 16 | 1 | 1 | 0 | - | - | 0 |
| 1 | 0 | 16 | 1 | 4 | 0 | - | - | 0 |
| 2 | 0 | 16 | 1 | 7 | 0 | - | - | 0 |
| 3 | 0 | 16 | 1 | 9 | 0 | - | - | 0 |
| 4 | 0 | 8 | 1 | 1 | 0 | - | - | 0 |
| 5 | 0 | 8 | 1 | 4 | 0 | - | - | 0 |
| 6 | 0 | 8 | 1 | 7 | 0 | - | - | 0 |
| 7 | 0 | 8 | 1 | 9 | 0 | - | - | 0 |
| 8 | 0 | 4 | 1 | 1 | 0 | - | - | 0 |
| 9 | 0 | 4 | 1 | 4 | 0 | - | - | 0 |
| 10 | 0 | 4 | 1 | 7 | 0 | - | - | 0 |
| 11 | 0 | 4 | 1 | 9 | 0 | - | - | 0 |
| 12 | 0 | 2 | 1 | 1 | 0 | - | - | 0 |
| 13 | 0 | 2 | 1 | 4 | 0 | - | - | 0 |

(----)

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 87 | A1 | 16 | 0 | 4,9 | 0 | 1 | 6 | 2 |
| 88 | A1 | 16 | 1 | 4 | 0 | 2 | 6 | 2 |
| 89 | A1 | 8 | 0 | 4,9 | 0 | 1 | 6 | 2 |
| 90 | A1 | 8 | 1 | 4 | 0 | 2 | 6 | 2 |
| 91 | A1 | 4 | 0 | 4,9 | 0 | 1 | 6 | 2 |
| 92 | A1 | 4 | 1 | 4,9 | 0 | 1 | 6 | 2 |
| 93 | A1 | 4 | 0 | 4 | 0 | 2 | 6 | 2 |
| 94 | A1 | 2 | 0 | 4,9 | 0 | 1 | 6 | 2 |
| 95 | A1 | 2 | 0 | 1 | 0 | 2 | 6 | 2 |
| 96 | A1 | 2 | 0 | 4 | 0 | 2 | 6 | 2 |
| 97 | A1 | 2 | 0 | 7 | 0 | 2 | 6 | 2 |
| 98 | A1 | 1 | 0 | 4 | 0 | 1 | 6 | 2 |
| 99 | A1 | 1 | 0 | 1,6 | 0 | 1 | 6 | 2 |
| 100 | A1 | 1 | 0 | 4,9 | 0 | 1 | 6 | 2 |
| 101 | A1 | 1 | 0 | 1 | 0 | 2 | 6 | 2 |
| 102 | A1 | 1 | 0 | 7 | 0 | 2 | 6 | 2 |
| 103 | A1 | 1 | 0 | 2,7 | 0 | 2 | 6 | 2 |
| 104 | A1 | 1 | 0 | 1,4,7 | 0 | 2 | 6 | 2 |

**Table 6.3.3.2-1: Supported combinations of $\Delta f_{RA}$ and $\Delta f$, and the corresponding value of $\bar{k}$.**

| $L_{RA}$ | $\Delta f_{RA}$ for PRACH | $\Delta f$ for PUSCH | $N_{RB}^{RA}$, allocation expressed in number of RBs for PUSCH | $\bar{k}$ |
|---|---|---|---|---|
| 839 | 1.25 | 15 | 6 | 7 |
| 839 | 1.25 | 30 | 3 | 1 |
| 839 | 1.25 | 60 | 2 | 133 |
| 839 | 5 | 15 | 24 | 12 |
| 839 | 5 | 30 | 12 | 10 |
| 839 | 5 | 60 | 6 | 7 |
| 139 | 15 | 15 | 12 | 2 |
| 139 | 15 | 30 | 6 | 2 |
| 139 | 15 | 60 | 3 | 2 |
| 139 | 30 | 15 | 24 | 2 |
| 139 | 30 | 30 | 12 | 2 |
| 139 | 30 | 60 | 6 | 2 |
| 139 | 60 | 60 | 12 | 2 |
| 139 | 60 | 120 | 6 | 2 |
| 139 | 120 | 60 | 24 | 2 |
| 139 | 120 | 120 | 12 | 2 |
| 139 | 120 | 480 | 3 | 1 |
| 139 | 120 | 960 | 2 | 23 |
| 139 | 480 | 120 | 48 | 2 |
| 139 | 480 | 480 | 12 | 2 |
| 139 | 480 | 960 | 6 | 2 |
| 139 | 960 | 120 | 96 | 2 |
| 139 | 960 | 480 | 24 | 2 |

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| | |
|---|---|
| $\Delta f_{RA}$ | Subcarrier spacing for random-access preambles |
| $\kappa$ | The ratio between $T_s$ and $T_c$ ; see clause 4.1 |
| $k$ | Subcarrier index relative to a reference |
| $l$ | OFDM symbol index relative to a reference |
| $\mu$ | Subcarrier spacing configuration, $\Delta f = 2^{\mu} \cdot 15\ [kHz]$ |
| $M_{bit}^{(q)}$ | Number of coded bits to transmit on a physical channel [for codeword $q$] |
| $M_{symb}^{(q)}$ | Number of modulation symbols to transmit on a physical channel [for codeword $q$] |
| $M_{symb}^{layer}$ | Number of modulation symbols to transmit per layer for a physical channel |
| $M_{sc}^{PUSCH}$ | Scheduled bandwidth for uplink transmission, expressed as a number of subcarriers |
| $M_{RB}^{PUSCH}$ | Scheduled bandwidth for uplink transmission, expressed as a number of resource blocks |
| $M_{symb}^{ap}$ | Number of modulation symbols to transmit per antenna port for a physical channel |
| $v$ | Number of transmission layers [101] |

193. For example the Accused Products are user equipment wherein the first sequence is a Zadoff-Chu (ZC) sequence. For *e.g.*, the Accused Product selects a random sequence number for the preamble. After choosing the preamble and sequence number, the UE transmits the preamble on the PRACH. Each cell has 64 PRACH preambles, which the mobile creates using parameters supplied by the base station. The preambles are based on Zadoff–Chu sequences. To create a preamble, the mobile begins by computing a Zadoff–Chu root sequence.

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### 6.3.3 Physical random-access channel

#### 6.3.3.1 Sequence generation

The set of random-access preambles $x_{u,v}(n)$ shall be generated according to

$$x_{u,v}(n) = x_u((n + C_v) \bmod L_{\mathrm{RA}})$$

$$x_u(i) = e^{-j\frac{\pi u i(i+1)}{L_{\mathrm{RA}}}}, i = 0,1,\ldots,L_{\mathrm{RA}} - 1$$

from which the frequency-domain representation shall be generated according to

$$y_{u,v}(n) = \sum_{m=0}^{L_{\mathrm{RA}}-1} x_{u,v}(m) \cdot e^{-j\frac{2\pi mn}{L_{\mathrm{RA}}}}$$

where $L_{\mathrm{RA}} = 839$, $L_{\mathrm{RA}} = 139$, $L_{\mathrm{RA}} = 1151$, or $L_{\mathrm{RA}} = 571$ depending on the PRACH preamble format as given by Tables 6.3.3.1-1 and 6.3.3.1-2.

There are 64 preambles defined in each time-frequency PRACH occasion, enumerated in increasing order of first increasing cyclic shift $C_v$ of a logical root sequence, and then in increasing order of the logical root sequence index, starting with the index obtained from the higher-layer parameter *prach-RootSequenceIndex* or *rootSequenceIndex-BFR* or by *msgA-PRACH-RootSequenceIndex* if configured and a type-2 random-access procedure is initiated as described in clause 8.1 of [5, TS 38.213]. Additional preamble sequences, in case 64 preambles cannot be generated from a single root Zadoff-Chu sequence, are obtained from the root sequences with the consecutive logical indexes until all the 64 sequences are found. The logical root sequence order is cyclic; the logical index 0 is consecutive to $L_{\mathrm{RA}} - 2$. The sequence number $u$ is obtained from the logical root sequence index according to Tables 6.3.3.1-3 to 6.3.3.1-4B. [102]

194. For example the Accused Products are user equipment wherein a transport channel corresponding to the first wireless signal is a Random Access Channel (RACH), a physical channel corresponding to the second wireless signal is a Physical Uplink Shared Channel (PUSCH). For example, the Accused Products are configured to transmit a first wireless signal (*e.g.*, Random Access Preamble for Msg1) on a first channel (*e.g.,* PRACH). For example, the "first wireless signal" may additionally be "Msg1" OR "Random Access Preamble" and can be transmitted on PRACH (first channel) on a PRACH occasion as specified in section 5.1.1 TS 38.321 v16.1.0. For example, the Accused Products are configured to transmit a second wireless signal (*e.g.*, Msg3) on a second channel (*e.g.*, PUSCH scheduled by a RAR UL grant).

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# 8 Random access procedure

Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements.

Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in clauses 8.1 through 8.4, or a Type-2 random access procedure as described in clauses 8.1 through 8.2A.

Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers:

- Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission).
- Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift ( $N_{CS}$ ), and set type (unrestricted, restricted set A, or restricted set B)).

From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution.[103]

195. For example, the Accused Products are user equipment wherein the first wireless signal is used to determine whether the second wireless signal is transmitted or not. For example, the Accused Products are configured to transmit the PRACH using reserved parts of the uplink resource grid that are known as PRACH occasions. These are defined using PRACH frequency occasions and PRACH time occasions and are the places where those frequency and time occasions intersect. After successful completion of the procedure after receiving the response, the UE can proceed with additional signalling for connection establishment, registration, and data transfer and transmission of PUSCH (Msg 3) (*i.e.*, the first wireless signal is used to determine whether the second wireless signal is transmitted or not).

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## 8 Random access procedure

Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements.

Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in clauses 8.1 through 8.4, or a Type-2 random access procedure as described in clauses 8.1 through 8.2A.

Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers:

- Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission).
- Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift ( $N_{CS}$ ), and set type (unrestricted, restricted set A, or restricted set B)).

From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution. [104]

196. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’721 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant’s customers and end-users, in this District and elsewhere in the United States. For example, Defendant’s customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the ’721 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[105] Because of Defendant’s inducement,

[104] TS38.213 V17.1.0

[105] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-

Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '721 Patent. Defendant performs these affirmative acts with knowledge of the '721 Patent and with the intent, or willful blindness, that the induced acts directly infringe the '721 Patent.

197. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '721 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant's affirmative acts of selling and offering to sell the Accused Products in this District and elsewhere in the United States and causing the Accused Products to be manufactured, used, sold, and offered for sale contribute to others' use and manufacture of the Accused Products such that the '721 Patent is directly infringed by others. The accused components within the Accused Products including, but not limited to, chipsets manufactured by Defendant, are material to the invention of the '721 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the '721 Patent. Defendant performs these affirmative acts with knowledge of the '721 Patent and with intent, or willful blindness, that they cause the direct infringement of the '721 Patent.

198. ABT has suffered damages as a result of Defendant's direct and indirect infringement of the '721 Patent in an amount to be proved at trial.

199. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant's infringement of the '721 Patent, for which there is no adequate remedy at law, unless

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get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

Defendant's infringement is enjoined by this Court.

200. On information and belief, Defendant acted egregiously and with willful misconduct in that their actions constituted direct or indirect infringement of a valid patent, and this was either known or so obvious that Defendant should have known about it. Defendant continues to infringe the '721 Patent by making, using, selling, offering for sale and/or importing in the United States the Accused Products and by inducing the direct infringing use, sale, offer for sale, and importation of the Accused Products by others, in reckless disregard of ABT's patent rights. Defendant has committed and continues to commit acts of infringement that Defendant actually knew or should have known constituted an unjustifiably high risk of infringement of at least one valid and enforceable claim of the '721 Patent. Upon information and belief, Defendant had actual knowledge of the '721 Patent from related prior litigations accusing either the same products involving Defendant and products with similar 5G functionalities involving direct competitors of Defendant. Defendant's infringement of the '721 Patent has been and continues to be willful, entitling ABT to an award of treble damages, reasonable attorney fees, and costs in bringing this action under 35 U.S.C. §§ 284 and 285.

## COUNT X
## (Infringement of the '426 Patent)

201. The preceding paragraphs are incorporated by reference as if fully set forth herein.

202. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the '426 Patent.

203. Defendant has and continues to directly infringe the '426 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '426 Patent. Such products include at least

Accused Products including, but not limited to, Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which are each a UE for paging, comprising: a first receiver, to monitor a first signaling in X time intervals; and a second receiver, to receive a first radio signal; wherein X is a positive integer; the first signaling is used for determining scheduling information for the first radio signal; the scheduling information comprises occupied time-frequency resource and adopted MCS; the first radio signal carries a paging message; the frequency domain resource used for transmitting the first signaling belongs to a first subband; the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and subcarrier spacing of subcarriers included in the first subband is used for determining the X time intervals; all subcarriers included in the first subband have an equal subcarrier spacing, any two of the X time intervals are orthogonal in time domain; the first signaling is transmitted through a PDCCH, the PDCCH has a Cyclic Redundancy Check (CRC) scrambled by a Paging Radio Network Temporary Identity (P-RNTI), the first radio signal is transmitted through a Physical Downlink Shared Channel (PDSCH); the PDCCH is transmitted in a Common Search Space (CSS).

204. For example, Defendant has and continue to directly infringe at least claim 11 of the ’426 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards such as the Accused Products (*e.g.*, 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware

for implementing 3rd Generation Partnership Product (3GPP) specifications).

205. For example, the Accused Products comprise a first receiver, to monitor a first signaling in X time intervals and a second receiver, to receive a first radio signal; wherein X is a positive integer. For example, the Accused Products monitor a first signaling (*e.g.*, paging DCI, P-RNTI) in X time intervals (*e.g.*, paging occasion or PDCCH monitoring occasions) and receives a first radio signal (*e.g.*, paging messages on the paging control channel/PDSCH) wherein X is a positive integer (*e.g.*, multiple time slots).

### 7.1 Discontinuous Reception for paging

The UE may use Discontinuous Reception (DRX) in RRC_IDLE and RRC_INACTIVE state in order to reduce power consumption. The UE monitors one paging occasion (PO) per DRX cycle. A PO is a set of PDCCH monitoring occasions and can consist of multiple time slots (e.g. subframe or OFDM symbol) where paging DCI can be sent (TS 38.213 [4]). One Paging Frame (PF) is one Radio Frame and may contain one or multiple PO(s) or starting point of a PO. [106]

### 4.2 Downlink

Table 4.2-1 specifies the mapping of the downlink transport channels to their corresponding physical channels. Table 4.2-2 specifies the mapping of the downlink control channel information to its corresponding physical channel.

**Table 4.2-1**

| TrCH | Physical Channel |
|---|---|
| DL-SCH | PDSCH |
| BCH | PBCH |
| PCH | PDSCH |

[107]

### 6.2.2 Logical Channels

Different kinds of data transfer services as offered by MAC. Each logical channel type is defined by what type of information is transferred. Logical channels are classified into two groups: Control Channels and Traffic Channels. Control channels are used for the transfer of control plane information only:

- Broadcast Control Channel (BCCH): a downlink channel for broadcasting system control information.
- Paging Control Channel (PCCH): a downlink channel that carries paging messages. [108]

[106] TS38.304 V15.3.0
[107] TS38.212 V15.3.0
[108] TS38.300 V15.5.0

### 6.2.3 Mapping to Transport Channels

In Downlink, the following connections between logical channels and transport channels exist:

- BCCH can be mapped to BCH;
- BCCH can be mapped to DL-SCH;
- PCCH can be mapped to PCH;

[109]

### 9.2.5 Paging

Paging allows the network to reach UEs in RRC_IDLE and in RRC_INACTIVE state through *Paging* messages, and to notify UEs in RRC_IDLE, RRC_INACTIVE and RRC_CONNECTED state of system information change (see subclause 7.3.3) and ETWS/CMAS indications (see subclause 16.4) through *Short Messages*. Both *Paging* messages and *Short Messages* are addressed with P-RNTI on PDCCH, but while the former is sent on PCCH, the latter is sent over PDCCH directly (see subclause 6.5 of TS 38.331 [12]).

[110]

206. For example, the Accused Products are a UE wherein the first signaling is used for determining scheduling information for the first radio signal; the scheduling information comprises occupied time-frequency resource and adopted MCS. For example, the Accused Products practice the first signaling (*e.g.*, paging DCI, P-RNTI) is used for determining scheduling information for the first radio signal; the scheduling information comprises occupied time-frequency resource (*e.g.*, frequency domain resource assignment; time domain resource assignment) and adopted Modulation Coding Scheme (MCS) (*e.g.*, modulation and coding scheme).

#### 7.3.1.2.1 Format 1_0

DCI format 1_0 is used for the scheduling of PDSCH in one DL cell.

[109] TS38.300 V15.5.0
[110] TS38.300 V15.5.0

The following information is transmitted by means of the DCI format 1_0 with CRC scrambled by P-RNTI:

- Short Messages Indicator – 2 bits according to Table 7.3.1.2.1-1.
- Short Messages – 8 bits, according to Subclause x.x of [9, TS38.331]. If only the scheduling information for Paging is carried, this bit field is reserved.
- Frequency domain resource assignment – $\lceil \log_2(N_{RB}^{DL,BWP}(N_{RB}^{DL,BWP}+1)/2) \rceil$ bits. If only the short message is carried, this bit field is reserved.
  - $N_{RB}^{DL,BWP}$ is the size of CORESET 0
- Time domain resource assignment – 4 bits as defined in Subclause 5.1.2.1 of [6, TS38.214]. If only the short message is carried, this bit field is reserved.
- VRB-to-PRB mapping – 1 bit according to Table 7.3.1.1.2-33. If only the short message is carried, this bit field is reserved.
- Modulation and coding scheme – 5 bits as defined in Subclause 5.1.3 of [6, TS38.214], using Table 5.1.3.1-1. If only the short message is carried, this bit field is reserved.

[111]

207. For example, the Accused Products are a UE wherein the first radio signal carries a paging message; the frequency domain resource used for transmitting the first signaling belongs to a first subband; the first subband comprises a positive integer number of consecutive subcarriers in frequency domain. For example, the Accused Products practice the first radio signal (*e.g.*, paging messages on the paging control channel/PDSCH) carries a paging message.

### 6.2.2 Logical Channels

Different kinds of data transfer services as offered by MAC. Each logical channel type is defined by what type of information is transferred. Logical channels are classified into two groups: Control Channels and Traffic Channels. Control channels are used for the transfer of control plane information only:

- Broadcast Control Channel (BCCH): a downlink channel for broadcasting system control information.
- Paging Control Channel (PCCH): a downlink channel that carries paging messages.

[112]

### 9.2.5 Paging

Paging allows the network to reach UEs in RRC_IDLE and in RRC_INACTIVE state through *Paging* messages, and to notify UEs in RRC_IDLE, RRC_INACTIVE and RRC_CONNECTED state of system information change (see subclause 7.3.3) and ETWS/CMAS indications (see subclause 16.4) through *Short Messages*. Both *Paging* messages and *Short Messages* are addressed with P-RNTI on PDCCH, but while the former is sent on PCCH, the latter is sent over PDCCH directly (see subclause 6.5 of TS 38.331 [12]).

[113]

[111] TS38.212 V15.3.0
[112] TS38.300 V15.5.0
[113] TS38.300 V15.5.0

208. For example, the frequency domain resource used for transmitting the first signaling (*e.g.*, PDSCH, PDCCH) belongs to a first subband (*e.g.*, bandwidth part). The bandwidth part (BWP) comprises of a set of Physical Resource Blocks (PRBs) which are measured from a reference resource block termed as Common Resource Block. As each of the Physical Resource Blocks comprises 12 subcarriers, the BWP comprises of a positive integer number of consecutive subcarriers in frequency domain.

### 4.4.5 Bandwidth part

A bandwidth part is a subset of contiguous common resource blocks defined in subclause 4.4.4.3 for a given numerology $\mu_i$ in bandwidth part $i$ on a given carrier. The starting position $N_{\mathrm{BWP},i}^{\mathrm{start},\mu}$ and the number of resource blocks $N_{\mathrm{BWP},i}^{\mathrm{size},\mu}$ in a bandwidth part shall fulfil $N_{\mathrm{grid},x}^{\mathrm{start},\mu} \le N_{\mathrm{BWP},i}^{\mathrm{start},\mu} < N_{\mathrm{grid},x}^{\mathrm{start},\mu} + N_{\mathrm{grid},x}^{\mathrm{size},\mu}$ and $N_{\mathrm{grid},x}^{\mathrm{start},\mu} < N_{\mathrm{BWP},i}^{\mathrm{size},\mu} + N_{\mathrm{BWP},i}^{\mathrm{start},\mu} \le N_{\mathrm{grid},x}^{\mathrm{start},\mu} + N_{\mathrm{grid},x}^{\mathrm{size},\mu}$, respectively. Configuration of a bandwidth part is described in clause 12 of [5, TS 38.213].

A UE can be configured with up to four bandwidth parts in the downlink with a single downlink bandwidth part being active at a given time. The UE is not expected to receive PDSCH, PDCCH, or CSI-RS (except for RRM) outside an active bandwidth part.

### 4.4.4 Resource blocks

#### 4.4.4.1 General

A resource block is defined as $N_{\mathrm{sc}}^{\mathrm{RB}} = 12$ consecutive subcarriers in the frequency domain.

## 4.2 Numerologies

Multiple OFDM numerologies are supported as given by Table 4.2-1 where $\mu$ and the cyclic prefix for a bandwidth part are obtained from the higher-layer parameter *subcarrierSpacing* and *cyclicPrefix*, respectively.

**Table 4.2-1: Supported transmission numerologies.**

| $\mu$ | $\Delta f = 2^{\mu} \cdot 15$ [kHz] | **Cyclic prefix** |
|---|---|---|
| 0 | 15 | Normal |
| 1 | 30 | Normal |
| 2 | 60 | Normal, Extended |
| 3 | 120 | Normal |
| 4 | 240 | Normal |

### 4.4.3 Resource elements

Each element in the resource grid for antenna port $p$ and subcarrier spacing configuration $\mu$ is called a resource element and is uniquely identified by $(k,l)_{p,\mu}$ where $k$ is the index in the frequency domain and $l$ refers to the symbol position in the time domain relative to some reference point. Resource element $(k,l)_{p,\mu}$ corresponds to a physical resource and the complex value $a_{k,l}^{(p,\mu)}$. When there is no risk for confusion, or no particular antenna port or subcarrier spacing is specified, the indices $p$ and $\mu$ may be dropped, resulting in $a_{k,l}^{(p)}$ or $a_{k,l}$.

#### 4.4.4.3 Common resource blocks

Common resource blocks are numbered from 0 and upwards in the frequency domain for subcarrier spacing configuration $\mu$. The center of subcarrier 0 of common resource block 0 for subcarrier spacing configuration $\mu$ coincides with 'point A'.

The relation between the common resource block number $n_{\mathrm{CRB}}^{\mu}$ in the frequency domain and resource elements $(k,$ for subcarrier spacing configuration $\mu$ is given by

$$n_{\mathrm{CRB}}^{\mu} = \left\lfloor \frac{k}{N_{\mathrm{sc}}^{\mathrm{RB}}} \right\rfloor$$

where $k$ is defined relative to point A such that $k = 0$ corresponds to the subcarrier centered around point A.

#### 4.4.4.4 Physical resource blocks

Physical resource blocks are defined within a bandwidth part and numbered from 0 to $N_{\mathrm{BWP},i}^{\mathrm{size}} - 1$ where $i$ is the number of the bandwidth part. The relation between the physical resource block $n_{\mathrm{PRB}}$ in bandwidth part $i$ and the common resource block $n_{\mathrm{CRB}}$ is given by

$$n_{\mathrm{CRB}} = n_{\mathrm{PRB}} + N_{\mathrm{BWP},i}^{\mathrm{start}}$$

[114]

## 12 Bandwidth part operation

If the UE is configured with a SCG, the UE shall apply the procedures described in this clause for both MCG and SCG

- When the procedures are applied for MCG, the terms 'secondary cell', 'secondary cells' , 'serving cell', 'serving cells' in this clause refer to secondary cell, secondary cells, serving cell, serving cells belonging to the MCG respectively.
- When the procedures are applied for SCG, the terms 'secondary cell', 'secondary cells', 'serving cell', 'serving cells' in this clause refer to secondary cell, secondary cells (not including PSCell), serving cell, serving cells belonging to the SCG respectively. The term 'primary cell' in this clause refers to the PSCell of the SCG.

A UE configured for operation in bandwidth parts (BWPs) of a serving cell, is configured by higher layers for the serving cell a set of at most four bandwidth parts (BWPs) for receptions by the UE (DL BWP set) in a DL bandwidth by parameter *BWP-Downlink* and a set of at most four BWPs for transmissions by the UE (UL BWP set) in an UL bandwidth by parameter *BWP-Uplink*.

[115]

[114] TS38.211 V15.2.0
[115] TS38.213 V15.3.0

– *BWP*

The *BWP* IE is used to configure a bandwidth part as defined in 38.211, section 4.2.2.

For each serving cell the network configures at least an initial bandwidth part comprising of at least a downlink bandwidth part and one (if the serving cell is configured with an uplink) or two (if using supplementary uplink (SUL)) uplink bandwidth parts. Furthermore, the network may configure additional uplink and downlink bandwidth parts for a serving cell.

The bandwidth part configuration is split into uplink and downlink parameters and into common and dedicated parameters. Common parameters (in BWP-UplinkCommon and BWP-DownlinkCommon) are "cell specific" and the network ensures the necessary alignment with corresponding parameters of other UEs. The common parameters of the initial bandwidth part of the PCell are also provided via system information. For all other serving cells, the network provides the common parameters via dedicated signalling.

***BWP* information element**

```
-- ASN1START
-- TAG-BANDWIDTH-PART-START

BWP ::=                             SEQUENCE {
    locationAndBandwidth                INTEGER (0..37949),
    subcarrierSpacing                   SubcarrierSpacing,
    cyclicPrefix                        ENUMERATED { extended }                    OPTIONAL    -- Need R
}


-- TAG-BANDWIDTH-PART-STOP
-- ASN1STOP
```

| ***BWP field descriptions*** |
|---|
| ***cyclicPrefix***<br>Indicates whether to use the extended cyclic prefix for this bandwidth part. If not set, the UE uses the normal cyclic prefix. Normal CP is supported for all numerologies and slot formats. Extended CP is supported only for 60 kHz subcarrier spacing. (see 38.211, section 4.2.2) |
| ***locationAndBandwidth***<br>Frequency domain location and bandwidth of this bandwidth part. The value of the field shall be interpreted as resource indicator value (RIV) as defined TS 38.214 with assumptions as described in TS 38.213, section 12, i.e. setting $N_{BWP}^{size}$=275. The first PRB is a PRB determined by subcarrierSpacing of this BWP and offsetToCarrier (configured in SCS-SpecificCarrier contained within FrequencyInfoDL / FrequencyInfoUL) corresponding to this subcarrier spacing. In case of TDD, a BWP-pair (UL BWP and DL BWP with the same bwp-Id) must have the same center frequency (see 38.213, section 12) |
| ***subcarrierSpacing***<br>Subcarrier spacing to be used in this BWP for all channels and reference signals unless explicitly configured elsewhere. Corresponds to subcarrier spacing according to 38.211, Table 4.2-1. The value kHz15 corresponds to μ=0, kHz30 to μ=1, and so on. Only the values 15, 30, or 60 kHz (<6GHz), and 60 or 120 kHz (>6GHz) are applicable. For the initial DL BWP this field has the same value as the field subCarrierSpacingCommon in MIB of the same serving cell. |

[116]

## 5.3 UE channel bandwidth

### 5.3.1 General

The UE channel bandwidth supports a single NR RF carrier in the uplink or downlink at the UE. From a BS perspective, different UE channel bandwidths may be supported within the same spectrum for transmitting to and receiving from UEs connected to the BS. Transmission of multiple carriers to the same UE (CA) or multiple carriers to different UEs within the BS channel bandwidth can be supported.

From a UE perspective, the UE is configured with one or more BWP / carriers, each with its own UE channel bandwidth. The UE does not need to be aware of the BS channel bandwidth or how the BS allocates bandwidth to different UEs.

The placement of the UE channel bandwidth for each UE carrier is flexible but can only be completely within the BS channel bandwidth.

### 5.3.2 Maximum transmission bandwidth configuration

The maximum transmission bandwidth configuration $N_{RB}$ for each UE channel bandwidth and subcarrier spacing is specified in Table 5.3.2-1.

**Table 5.3.2-1: Maximum transmission bandwidth configuration $N_{RB}$**

| SCS (kHz) | 5MHz | 10MHz | 15MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ |
| 15 | 25 | 52 | 79 | 106 | 133 | 160 | 216 | 270 | N/A | N/A | N/A | N/A |
| 30 | 11 | 24 | 38 | 51 | 65 | 78 | 106 | 133 | 162 | 217 | 245 | 273 |
| 60 | N/A | 11 | 18 | 24 | 31 | 38 | 51 | 65 | 79 | 107 | 121 | 135 |

[117]

[116] TS38.331 V15.3.0
[117] TS38.101 V15.3.0

5.1.2.2.2 Downlink resource allocation type 1

In downlink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved or interleaved virtual resource blocks within the active bandwidth part of size $N_{\mathrm{BWP}}^{size}$ PRBs except for the case when DCI format 1_0 is decoded in any common search space in which case the size of CORESET 0 shall be used.

A downlink type 1 resource allocation field consists of a resource indication value ($RIV$) corresponding to a starting virtual resource block ( $RB_{start}$ ) and a length in terms of contiguously allocated resource blocks $L_{RBs}$ . The resource indication value is defined by

if $(L_{RBs} - 1) \leq \lfloor N_{BWP}^{size} / 2 \rfloor$ then

$$RIV = N_{BWP}^{size}(L_{RBs} - 1) + RB_{start}$$

else

$$RIV = N_{BWP}^{size}(N_{BWP}^{size} - L_{RBs} + 1) + (N_{BWP}^{size} - 1 - RB_{start})$$

where $L_{RBs} \geq 1$ and shall not exceed $N_{BWP}^{size} - RB_{start}$ . [118]

209. For example, the Accused Products are a UE wherein subcarrier spacing of subcarriers included in the first subband is used for determining the X time intervals. For example, the location of the first subband in frequency domain (*e.g.*, pdcch-ConfigSIB1) and subcarrier spacing of subcarriers (*e.g.*, subcarrierSpacingCommon) included in the first subband (*e.g.*, BWP) are used for determining X time intervals (*e.g.*, firstPDCCH-MonitoringOccasionOfPO).

7.1 Discontinuous Reception for paging

The PDCCH monitoring occasions for paging are determined according to *pagingSearchSpace* as specified in TS 38.213 [4] and *firstPDCCH-MonitoringOccasionOfPO* if configured as specified in TS 38.331 [3]. When *SearchSpaceId* = 0 is configured for *pagingSearchSpace*, the PDCCH monitoring occasions for paging are same as for RMSI as defined in clause 13 in TS 38.213 [4].

When *SearchSpaceId* = 0 is configured for *pagingSearchSpace*, Ns is either 1 or 2. For Ns = 1, there is only one PO which starts from the first PDCCH monitoring occasion for paging in the PF. For Ns = 2, PO is either in the first half frame (i_s = 0) or the second half frame (i_s = 1) of the PF.

When *SearchSpaceId* other than 0 is configured for *pagingSearchSpace,* the UE monitors the $(i_s + 1)^{th}$ PO. A PO is a set of 'S' consecutive PDCCH monitoring occasions where 'S' is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in *SIB1*. The $K^{th}$ PDCCH monitoring occasion for paging in the PO corresponds to the $K^{th}$ transmitted SSB. The PDCCH monitoring occasions for paging which do not overlap with UL symbols (determined according to *tdd-UL-DL-ConfigurationCommon*) are sequentially numbered from zero starting from the first PDCCH monitoring occasion for paging in the PF. When *firstPDCCH-MonitoringOccasionOfPO* is present, the starting PDCCH monitoring occasion number of $(i_s + 1)^{th}$ PO is the $(i_s + 1)^{th}$ value of the *firstPDCCH-MonitoringOccasionOfPO* parameter; otherwise, it is equal to i_s * S.

[119]

6.3.2 Radio resource control information elements

[118] TS38.214 V15.3.0
[119] TS38.304 V15.3.0

```
firstPDCCH-MonitoringOccasionOfPO   CHOICE {
    sCS15KHZoneT                                                          SEQUENCE (SIZE (1..4)) OF INTEGER (0..139),
    sCS30KHZoneT-SCS15KHZhalfT                                            SEQUENCE (SIZE (1..4)) OF INTEGER (0..279),
    sCS60KHZoneT-SCS30KHZhalfT-SCS15KHZquarterT                           SEQUENCE (SIZE (1..4)) OF INTEGER (0..559),
    sCS120KHZoneT-SCS60KHZhalfT-SCS30KHZquarterT-SCS15KHZoneEighthT       SEQUENCE (SIZE (1..4)) OF INTEGER (0..1119),
    sCS120KHZhalfT-SCS60KHZquarterT-SCS30KHZoneEighthT-SCS15KHZoneSixteenthT   SEQUENCE (SIZE (1..4)) OF INTEGER (0..2239),
    sCS120KHZquarterT-SCS60KHZoneEighthT-SCS30KHZoneSixteenthT            SEQUENCE (SIZE (1..4)) OF INTEGER (0..4479),
    sCS120KHZoneEighthT-SCS60KHZoneSixteenthT                             SEQUENCE (SIZE (1..4)) OF INTEGER (0..8959),
    sCS120KHZoneSixteenthT                                                SEQUENCE (SIZE (1..4)) OF INTEGER (0..17919)
```
[120]

210. For example, in identifying the time interval of a subband, the subcarrier spacing information is sufficient to determine the time interval. The standard includes a disclosure that the subcarrier spacing information provided by $\mu$ can be used to derive subband location (*e.g.*, BWP) with respect to a common resource block (*e.g.*, CRB0).[121] For example, subcarrier spacing information (*e.g.*, subcarrierSpacingCommon) is already included in the MIB information element and can be transmitted from network to UE in BCH/BCCH channel.

### 6.2.2 Message definitions

– *MIB*

The *MIB* includes the system information transmitted on BCH.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: BCCH

Direction: Network to UE

***MIB***

```
-- ASN1START
-- TAG-MIB-START

MIB ::=                             SEQUENCE {
    systemFrameNumber                   BIT STRING (SIZE (6)),
    subCarrierSpacingCommon             ENUMERATED {scs15or60, scs30or120},
    ssb-SubcarrierOffset                INTEGER (0..15),
    dmrs-TypeA-Position                 ENUMERATED {pos2, pos3},
    pdcch-ConfigSIB1                    PDCCH-ConfigSIB1,
    cellBarred                          ENUMERATED {barred, notBarred},
    intraFreqReselection                ENUMERATED {allowed, notAllowed},
    spare                               BIT STRING (SIZE (1))
}

-- TAG-MIB-STOP
-- ASN1STOP
```

[120] TS38.331 V15.3.0

[121] https://www.sharetechnote.com/html/5G/5G_ResourceGrid.html; https://www.rfwireless-world.com/5G/5G-NR-Resource-Grid-vs-Resource-Block-vs-Resource-Element.html

| MIB field descriptions |
|---|
| ***cellBarred***<br>barred means the cell is barred, as defined in TS 38.304 [20]. |
| ***dmrs-TypeA-Position***<br>Position of (first) DM-RS for downlink (see 38.211, section 7.4.1.1.1) and uplink (see 38.211, section 6.4.1.1.3). |
| ***intraFreqReselection***<br>Controls cell selection/reselection to intra-frequency cells when the highest ranked cell is barred, or treated as barred by the UE, as specified in TS 38.304 [20]. |
| ***pdcch-ConfigSIB1***<br>See TS 38.213 [13]. Determines a common *ControlResourceSet* (CORESET) a common search space and necessary PDCCH parameters. If the field *ssb-SubcarrierOffset* indicates that *SIB1* is not present, the field *pdcch-ConfigSIB1* indicate the frequency positions where the UE may find SS/PBCH block with *SIB1* or the frequency range where the network does not provide SS/PBCH block with *SIB1* (see TS 38.213 [13], section 13). |
| ***ssb-SubcarrierOffset***<br>Corresponds to $k_{SSB}$ (see TS 38.213 [13]), which is the frequency domain offset between SSB and the overall resource block grid in number of subcarriers. (See 38.211).<br>The value range of this field may be extended by an additional most significant bit encoded within PBCH as specified in 38.213 [13].<br>This field may indicate that this beam does not provide *SIB1* and that there is hence no common CORESET (see TS 38.213 [13], section 13). In this case, the field *pdcch-ConfigSIB1* may indicate the frequency positions where the UE may (not) find a SS/PBCH with a control resource set and search space for SIB1 (see 38.213 [13], section 13). |
| ***subCarrierSpacingCommon***<br>Subcarrier spacing for SIB1, Msg.2/4 for initial access and broadcast SI-messages. If the UE acquires this MIB on a carrier frequency <6GHz, the value *scs15or60* corresponds to 15 Khz and the value *scs30or120* corresponds to 30 kHz. If the UE acquires this MIB on a carrier frequency >6GHz, the value *scs15or60* corresponds to 60 Khz and the value *scs30or120* corresponds to 120 kHz. |
| ***systemFrameNumber***<br>The 6 most significant bit (MSB) of the 10-bit System Frame Number. The 4 LSB of the SFN are conveyed in the PBCH transport block as part of channel coding (i.e. outside the MIB encoding). |

[122]

211. For example, the BWP information element comprises: 1) locationAndBandwidth; and 2) subcarrier spacing.

### 6.3.2 Radio resource control information elements

– *BWP*

The *BWP* IE is used to configure a bandwidth part as defined in 38.211, section 4.2.2.

For each serving cell the network configures at least an initial bandwidth part comprising of at least a downlink bandwidth part and one (if the serving cell is configured with an uplink) or two (if using supplementary uplink (SUL)) uplink bandwidth parts. Furthermore, the network may configure additional uplink and downlink bandwidth parts for a serving cell.

The bandwidth part configuration is split into uplink and downlink parameters and into common and dedicated parameters. Common parameters (in BWP-UplinkCommon and BWP-DownlinkCommon) are "cell specific" and the network ensures the necessary alignment with corresponding parameters of other UEs. The common parameters of the initial bandwidth part of the PCell are also provided via system information. For all other serving cells, the network provides the common parameters via dedicated signalling.

**BWP information element**

```
-- ASN1START
-- TAG-BANDWIDTH-PART-START

BWP ::=                             SEQUENCE {
    locationAndBandwidth                INTEGER (0..37949),
    subcarrierSpacing                   SubcarrierSpacing,
    cyclicPrefix                        ENUMERATED { extended }                    OPTIONAL    -- Need R
}


-- TAG-BANDWIDTH-PART-STOP
-- ASN1STOP
```

| BWP field descriptions |
|---|
| ***cyclicPrefix***<br>Indicates whether to use the extended cyclic prefix for this bandwidth part. If not set, the UE uses the normal cyclic prefix. Normal CP is supported for all numerologies and slot formats. Extended CP is supported only for 60 kHz subcarrier spacing. (see 38.211, section 4.2.2) |
| ***locationAndBandwidth***<br>Frequency domain location and bandwidth of this bandwidth part. The value of the field shall be interpreted as resource indicator value (RIV) as defined TS 38.214 with assumptions as described in TS 38.213, section 12, i.e. setting $N_{BWP}^{size}$=275. The first PRB is a PRB determined by subcarrierSpacing of this BWP and offsetToCarrier (configured in SCS-SpecificCarrier contained within FrequencyInfoDL / FrequencyInfoUL) corresponding to this subcarrier spacing. In case of TDD, a BWP-pair (UL BWP and DL BWP with the same bwp-Id) must have the same center frequency (see 38.213, section 12) |
| ***subcarrierSpacing***<br>Subcarrier spacing to be used in this BWP for all channels and reference signals unless explicitly configured elsewhere. Corresponds to subcarrier spacing according to 38.211, Table 4.2-1. The value kHz15 corresponds to μ=0, kHz30 to μ=1, and so on. Only the values 15, 30, or 60 kHz (<6GHz), and 60 or 120 kHz (>6GHz) are applicable. For the initial DL BWP this field has the same value as the field subCarrierSpacingCommon in MIB of the same serving cell. |

[123]

212. For example, the Accused Products are a UE wherein all subcarriers included in the first subband have an equal subcarrier spacing, any two of the X time intervals are orthogonal in

[122] TS38.331 V15.3.0

[123] TS38.331 V15.3.0

time domain. For example, Defendant and the Accused Products practice all subcarriers included in the first subband have an equal subcarrier spacing, any two of the X time intervals are orthogonal in time domain. For example, subcarrier spacing information (*e.g.*, subcarrierSpacingCommon) included in the MIB information element or subcarrier spacing information (*e.g.*, subcarrierSpacing) included in BWP IE of the first subband (*e.g.*, BWP) defines the subcarrier spacing and is same for whole BWP.

6.2.2 Message definitions

– *MIB*

The *MIB* includes the system information transmitted on BCH.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: BCCH

Direction: Network to UE

***MIB***

```
-- ASN1START
-- TAG-MIB-START

MIB ::=                                 SEQUENCE {
    systemFrameNumber                       BIT STRING (SIZE (6)),
    subCarrierSpacingCommon                 ENUMERATED {scs15or60, scs30or120},
    ssb-SubcarrierOffset                    INTEGER (0..15),
    dmrs-TypeA-Position                     ENUMERATED {pos2, pos3},
    pdcch-ConfigSIB1                        PDCCH-ConfigSIB1,
    cellBarred                              ENUMERATED {barred, notBarred},
    intraFreqReselection                    ENUMERATED {allowed, notAllowed},
    spare                                   BIT STRING (SIZE (1))
}

-- TAG-MIB-STOP
-- ASN1STOP
```

| ***MIB field descriptions*** |
|---|
| ***cellBarred***<br>barred means the cell is barred, as defined in TS 38.304 [20]. |
| ***dmrs-TypeA-Position***<br>Position of (first) DM-RS for downlink (see 38.211, section 7.4.1.1.1) and uplink (see 38.211, section 6.4.1.1.3). |
| ***intraFreqReselection***<br>Controls cell selection/reselection to intra-frequency cells when the highest ranked cell is barred, or treated as barred by the UE, as specified in TS 38.304 [20]. |
| ***pdcch-ConfigSIB1***<br>See TS 38.213 [13]. Determines a common *ControlResourceSet* (CORESET) a common search space and necessary PDCCH parameters. If the field *ssb-SubcarrierOffset* indicates that *SIB1* is not present, the field *pdcch-ConfigSIB1* indicate the frequency positions where the UE may find SS/PBCH block with *SIB1* or the frequency range where the network does not provide SS/PBCH block with *SIB1* (see TS 38.213 [13], section 13). |
| ***ssb-SubcarrierOffset***<br>Corresponds to $k_{SSB}$ (see TS 38.213 [13]), which is the frequency domain offset between SSB and the overall resource block grid in number of subcarriers. (See 38.211).<br>The value range of this field may be extended by an additional most significant bit encoded within PBCH as specified in 38.213 [13].<br>This field may indicate that this beam does not provide *SIB1* and that there is hence no common CORESET (see TS 38.213 [13], section 13). In this case, the field *pdcch-ConfigSIB1* may indicate the frequency positions where the UE may (not) find a SS/PBCH with a control resource set and search space for SIB1 (see 38.213 [13], section 13). |
| ***subCarrierSpacingCommon***<br>Subcarrier spacing for SIB1, Msg.2/4 for initial access and broadcast SI-messages. If the UE acquires this MIB on a carrier frequency <6GHz, the value *scs15or60* corresponds to 15 Khz and the value *scs30or120* corresponds to 30 kHz. If the UE acquires this MIB on a carrier frequency >6GHz, the value *scs15or60* corresponds to 60 Khz and the value *scs30or120* corresponds to 120 kHz. |
| ***systemFrameNumber***<br>The 6 most significant bit (MSB) of the 10-bit System Frame Number. The 4 LSB of the SFN are conveyed in the PBCH transport block as part of channel coding (i.e. outside the MIB encoding). |

[124]

213. For example, the BWP information element comprises subcarrier spacing.

[124] TS38.331 V15.3.0

6.3.2 Radio resource control information elements

– *BWP*

The *BWP* IE is used to configure a bandwidth part as defined in 38.211, section 4.2.2.

For each serving cell the network configures at least an initial bandwidth part comprising of at least a downlink bandwidth part and one (if the serving cell is configured with an uplink) or two (if using supplementary uplink (SUL)) uplink bandwidth parts. Furthermore, the network may configure additional uplink and downlink bandwidth parts for a serving cell.

The bandwidth part configuration is split into uplink and downlink parameters and into common and dedicated parameters. Common parameters (in BWP-UplinkCommon and BWP-DownlinkCommon) are "cell specific" and the network ensures the necessary alignment with corresponding parameters of other UEs. The common parameters of the initial bandwidth part of the PCell are also provided via system information. For all other serving cells, the network provides the common parameters via dedicated signalling.

***BWP* information element**

```
-- ASN1START
-- TAG-BANDWIDTH-PART-START

BWP ::=                             SEQUENCE {
    locationAndBandwidth                INTEGER (0..37949),
    subcarrierSpacing                   SubcarrierSpacing,
    cyclicPrefix                        ENUMERATED { extended }                                  OPTIONAL    -- Need R
}


-- TAG-BANDWIDTH-PART-STOP
-- ASN1STOP
```

| ***BWP field descriptions*** |
|---|
| ***cyclicPrefix***<br>Indicates whether to use the extended cyclic prefix for this bandwidth part. If not set, the UE uses the normal cyclic prefix. Normal CP is supported for all numerologies and slot formats. Extended CP is supported only for 60 kHz subcarrier spacing. (see 38.211, section 4.2.2) |
| ***locationAndBandwidth***<br>Frequency domain location and bandwidth of this bandwidth part. The value of the field shall be interpreted as resource indicator value (RIV) as defined TS 38.214 with assumptions as described in TS 38.213, section 12, i.e. setting $N_{BWP}^{size}$=275. The first PRB is a PRB determined by subcarrierSpacing of this BWP and offsetToCarrier (configured in SCS-SpecificCarrier contained within FrequencyInfoDL / FrequencyInfoUL) corresponding to this subcarrier spacing. In case of TDD, a BWP-pair (UL BWP and DL BWP with the same bwp-Id) must have the same center frequency (see 38.213, section 12) |
| ***subcarrierSpacing***<br>Subcarrier spacing to be used in this BWP for all channels and reference signals unless explicitly configured elsewhere. Corresponds to subcarrier spacing according to 38.211, Table 4.2-1. The value kHz15 corresponds to μ=0, kHz30 to μ=1, and so on. Only the values 15, 30, or 60 kHz (<6GHz), and 60 or 120 kHz (>6GHz) are applicable. For the initial DL BWP this field has the same value as the field subCarrierSpacingCommon in MIB of the same serving cell. |

[125]

214. For further example, any two of the X time intervals (*e.g.*, PDCCH monitoring occasions/paging occasion (PO)) can consist of ODFM symbols are orthogonal in time domain.

[125] TS38.331 V15.3.0

# 7 Paging

## 7.1 Discontinuous Reception for paging

The UE may use Discontinuous Reception (DRX) in RRC_IDLE and RRC_INACTIVE state in order to reduce power consumption. The UE monitors one paging occasion (PO) per DRX cycle. A PO is a set of PDCCH monitoring occasions and can consist of multiple time slots (e.g. subframe or OFDM symbol) where paging DCI can be sent (TS 38.213 [4]). One Paging Frame (PF) is one Radio Frame and may contain one or multiple PO(s) or starting point of a PO.

In multi-beam operations, the UE assumes that the same paging message is repeated in all transmitted beams and thus the selection of the beam(s) for the reception of the paging message is up to UE implementation. The paging message is same for both RAN initiated paging and CN initiated paging.

The UE initiates RRC Connection Resume procedure upon receiving RAN initiated paging. If the UE receives a CN initiated paging in RRC_INACTIVE state, the UE moves to RRC_IDLE and informs NAS.

The PF and PO for paging are determined by the following formulae:

SFN for the PF is determined by:

(SFN + PF_offset) mod T = (T div N)*(UE_ID mod N)

Index (i_s), indicating the index of the PO is determined by:

i_s = floor (UE_ID/N) mod Ns

The PDCCH monitoring occasions for paging are determined according to *pagingSearchSpace* as specified in TS 38.213 [4] and *firstPDCCH-MonitoringOccasionOfPO* if configured as specified in TS 38.331 [3]. When *SearchSpaceId* = 0 is configured for *pagingSearchSpace*, the PDCCH monitoring occasions for paging are same as for RMSI as defined in clause 13 in TS 38.213 [4].

When *SearchSpaceId* = 0 is configured for *pagingSearchSpace*, Ns is either 1 or 2. For Ns = 1, there is only one PO which starts from the first PDCCH monitoring occasion for paging in the PF. For Ns = 2, PO is either in the first half frame (i_s = 0) or the second half frame (i_s = 1) of the PF.

When *SearchSpaceId* other than 0 is configured for *pagingSearchSpace,* the UE monitors the $(i_s + 1)^{th}$ PO. A PO is a set of 'S' consecutive PDCCH monitoring occasions where 'S' is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in *SIB1*. The $K^{th}$ PDCCH monitoring occasion for paging in the PO corresponds to the $K^{th}$ transmitted SSB. The PDCCH monitoring occasions for paging which do not overlap with UL symbols (determined according to *tdd-UL-DL-ConfigurationCommon*) are sequentially numbered from zero starting from the first PDCCH monitoring occasion for paging in the PF. When *firstPDCCH-MonitoringOccasionOfPO* is present, the starting PDCCH monitoring occasion number of $(i_s + 1)^{th}$ PO is the $(i_s + 1)^{th}$ value of the *firstPDCCH-MonitoringOccasionOfPO* parameter; otherwise, it is equal to i_s * S. [126]

215. For example, the Accused Products are a UE wherein the first signaling is transmitted through a PDCCH, the PDCCH has a Cyclic Redundancy Check (CRC) scrambled by a Paging Radio Network Temporary Identity (P-RNTI), the first radio signal is transmitted through a Physical Downlink Shared Channel (PDSCH); the PDCCH is transmitted in a Common Search Space (CSS). For example, the Accused Products practice the first signaling (*e.g.*, paging DCI, P-

[126] TS38.304 V15.3.0

RNTI) is transmitted through a PDCCH, the PDCCH has a Cyclic Redundancy Check (CRC) scrambled by a Paging Radio Network Temporary Identity (P-RNTI). Further, the first radio signal (*e.g.*, paging messages on the paging control channel/PDSCH) scheduled by paging DCI carries a paging message and is transmitted through a Physical Downlink Shared Channel (PDSCH). Also, the PDCCH is transmitted on a common search space.

### 7.1 Discontinuous Reception for paging

The UE may use Discontinuous Reception (DRX) in RRC_IDLE and RRC_INACTIVE state in order to reduce power consumption. The UE monitors one paging occasion (PO) per DRX cycle. A PO is a set of PDCCH monitoring occasions and can consist of multiple time slots (e.g. subframe or OFDM symbol) where paging DCI can be sent (TS 38.213 [4]). One Paging Frame (PF) is one Radio Frame and may contain one or multiple PO(s) or starting point of a PO. [127]

### 9.2.5 Paging

Paging allows the network to reach UEs in RRC_IDLE and in RRC_INACTIVE state through *Paging* messages, and to notify UEs in RRC_IDLE, RRC_INACTIVE and RRC_CONNECTED state of system information change (see subclause 7.3.3) and ETWS/CMAS indications (see subclause 16.4) through *Short Messages*. Both *Paging* messages and *Short Messages* are addressed with P-RNTI on PDCCH, but while the former is sent on PCCH, the latter is sent over PDCCH directly (see subclause 6.5 of TS 38.331 [12]). [128]

### 7.3.1.2 DCI formats for scheduling of PDSCH

#### 7.3.1.2.1 Format 1_0

[127] TS38.304 V15.3.0
[128] TS38.300 V15.5.0

The following information is transmitted by means of the DCI format 1_0 with CRC scrambled by P-RNTI:

- Short Messages Indicator – 2 bits according to Table 7.3.1.2.1-1.
- Short Messages – 8 bits, according to Subclause x.x of [9, TS38.331]. If only the scheduling information for Paging is carried, this bit field is reserved.
- Frequency domain resource assignment – $\lceil \log_2(N_{RB}^{DL,BWP}(N_{RB}^{DL,BWP}+1)/2) \rceil$ bits. If only the short message is carried, this bit field is reserved.
  - $N_{RB}^{DL,BWP}$ is the size of CORESET 0
- Time domain resource assignment – 4 bits as defined in Subclause 5.1.2.1 of [6, TS38.214]. If only the short message is carried, this bit field is reserved.
- VRB-to-PRB mapping – 1 bit according to Table 7.3.1.1.2-33. If only the short message is carried, this bit field is reserved.
- Modulation and coding scheme – 5 bits as defined in Subclause 5.1.3 of [6, TS38.214], using Table 5.1.3.1-1. If only the short message is carried, this bit field is reserved.

[129]

## 10.1 UE procedure for determining physical downlink control channel assignment

A set of PDCCH candidates for a UE to monitor is defined in terms of PDCCH search space sets. A search space set can be a common search space set or a UE-specific search space set. A UE monitors PDCCH candidates in one or more of the following search spaces sets

- a Type2-PDCCH common search space set configured by *pagingSearchSpace* in *PDCCH-ConfigCommon* for a DCI format with CRC scrambled by a P-RNTI on the primary cell;

[130]

216. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’426 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant’s customers and end-users, in this District and elsewhere in the United States. For example, Defendant’s customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the ’426 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the

[129] TS38.212 V15.3.0
[130] TS38.213 V15.3.0

Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[131] Because of Defendant's inducement, Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '426 Patent. Defendant performs these affirmative acts with knowledge of the '426 Patent and with the intent, or willful blindness, that the induced acts directly infringe the '426 Patent.

217. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '426 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant's affirmative acts of selling and offering to sell the Accused Products in this District and elsewhere in the United States and causing the Accused Products to be manufactured, used, sold, and offered for sale contribute to others' use and manufacture of the Accused Products such that the '426 Patent is directly infringed by others. The accused components within the Accused Products including, but not limited to, chipsets manufactured by Defendant, are material to the invention of the '426 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the '426 Patent. Defendant performs these affirmative acts with knowledge of the '426 Patent and with intent, or willful blindness, that they cause the direct

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[131] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

infringement of the ’426 Patent.

218. ABT has suffered damages as a result of Defendant’s direct and indirect infringement of the ’426 Patent in an amount to be proved at trial.

219. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant’s infringement of the ’426 Patent, for which there is no adequate remedy at law, unless Defendant’s infringement is enjoined by this Court.

220. On information and belief, Defendant acted egregiously and with willful misconduct in that their actions constituted direct or indirect infringement of a valid patent, and this was either known or so obvious that Defendant should have known about it. Defendant continue to infringe the ’426 Patent by making, using, selling, offering for sale and/or importing in the United States the Accused Products and by inducing the direct infringing use, sale, offer for sale, and importation of the Accused Products by others, in reckless disregard of ABT’s patent rights. Defendant has committed and continues to commit acts of infringement that Defendant actually knew or should have known constituted an unjustifiably high risk of infringement of at least one valid and enforceable claim of the ’426 Patent. Upon information and belief, Defendant had actual knowledge of the ’426 Patent from related prior litigations accusing either the same products involving Defendant and products with similar 5G functionalities involving direct competitors of Defendant. Defendant’s infringement of the ’426 Patent has been and continues to be willful, entitling ABT to an award of treble damages, reasonable attorney fees, and costs in bringing this action under 35 U.S.C. §§ 284 and 285.

**COUNT XI**
**(Infringement of the ‘110 Patent)**

221. The preceding paragraphs are incorporated by reference as if fully set forth herein.

222. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the ’110 Patent.

223. Defendant has and continue to directly infringe the ’110 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the ’110 Patent. Such products include at least Accused Products including, but not limited to, Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which are each a user equipment (UE) for multi-antenna transmission, comprising: a first transceiver, receiving a first radio signal; and a second receiver, receiving a first signaling; wherein the first radio signal is transmitted by K antenna port groups; the antenna port group includes a positive integer number of antenna port(s); a first antenna port group is one of the K antenna port groups; the first signaling is used to determine a first time resource pool; a second antenna virtualization vector is associated with the first antenna port group; the second antenna virtualization vector is an antenna virtualization vector available to the user equipment in the first time resource pool; and the K is a positive integer greater than 1; the first radio signal includes one or more of PSS (Primary Synchronization Signal), SSS (Secondary Synchronization Signal), MIB (Master Information Block)/SIB (System Information Block) or CSI-RS (Channel State Information Reference signal); the first signaling is a downlink signaling.

224. For example, Defendant has and continues to directly infringe at least claim 1 of the ’110 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards such as the Accused Products (*e.g.*, 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware for implementing 3rd Generation Partnership Product (3GPP) specifications).

225. For example, the Accused Products comprise a first transceiver, receiving a first radio signal. For example, the Accused Products receive a first radio signal (*e.g.*, CSI-RS or SS/PBCH) from a base station (*e.g.*, gNB). For example, the first radio signal comprises CSI-RS resources and/or SS/PBCH Block resources.

### 5.1.6 UE procedure for receiving downlink reference signals

#### 5.1.6.1 CSI-RS reception procedure

The CSI-RS defined in Subclause 7.4.1.5 of [4, TS 38.211], may be used for time/frequency tracking, CSI computation, L1-RSRP computation and mobility.

If the UE is configured with a CSI-RS resource and a search space set associated with a CORESET in the same OFDM symbol(s), the UE may assume that the CSI-RS and a PDCCH DM-RS transmitted in all the search space sets associated with CORESET are quasi co-located with 'QCL-TypeD', if 'QCL-TypeD' is applicable. Furthermore, the UE shall not expect to be configured with the CSI-RS in PRBs that overlap those of the CORESET in the OFDM symbols occupied by the search space set(s).

A UE in RRC connected mode is expected to receive the higher layer UE specific configuration of a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info*. [132]

#### 5.1.6.1.2 CSI-RS for L1-RSRP computation

If the UE is configured with a *CSI-ReportConfig* with *reportQuantity* set to "cri-RSRP", or "none" and if the *CSI-ResourceConfig* for channel measurement (higher layer parameter *resourcesForChannelMeasurement*) contains a *NZP-CSI-RS-ResourceSet* that is configured with the higher layer parameter *repetition* and without the higher layer parameter *trs-Info*, the UE can only be configured with the same number (1 or 2) of ports with the higher layer parameter *nrofPorts* for all CSI-RS resources within the set. If the UE is configured with the CSI-RS resource in the same OFDM symbol(s) as an SS/PBCH block, the UE may assume that the CSI-RS and the SS/PBCH block are quasi co-located with 'QCL-TypeD' if 'QCL-TypeD' is applicable. Furthermore, the UE shall not expect to be configured with the CSI-RS in PRBs that overlap with those of the SS/PBCH block, and the UE shall expect that the same subcarrier spacing is used for both the CSI-RS and the SS/PBCH block. [133]

[132] TS38.214 V15.3.0
[133] TS38.214 V15.3.0

### 7.4.1.5 CSI reference signals

#### 7.4.1.5.1 General

Zero-power (ZP) and non-zero-power (NZP) CSI-RS are defined

- for a non-zero-power CSI-RS configured by the *NZP-CSI-RS-Resource* IE or by the *CSI-RS-Resource-Mobility* field in the *CSI-RS-ResourceConfigMobility* IE, the sequence shall be generated according to clause 7.4.1.5.2 and mapped to resource elements according to clause 7.4.1.5.3
- for a zero-power CSI-RS configured by the *ZP-CSI-RS-Resource* IE, the UE shall assume that the resource elements defined in clause 7.4.1.5.3 are not used for PDSCH transmission subject to clause 5.1.4.2 of [6, TS 38.214]. The UE performs the same measurement/reception on channels/signals except PDSCH regardless of whether they collide with ZP CSI-RS or not.

[134]

226. For example, the Accused Products comprise a second receiver, receiving a first signaling. For example, the Accused Products receive a first signaling (*e.g.*, SearchSpace IE, ConfiguredGrantConf IE, DCI format 1_0, DCI format 1_1,) from the base station.

### 4.2.2 Physical channels and modulation

The physical channels defined in the downlink are:

- the Physical Downlink Shared Channel (PDSCH),
- the Physical Downlink Control Channel (PDCCH),
- the Physical Broadcast Channel (PBCH),

[135]

### 6.3.2 Radio resource control information elements

– *SearchSpace*

The IE *SearchSpace* defines how/where to search for PDCCH candidates. Each search space is associated with one *ControlResourceSet*.

[136]

### 6.3.2 Radio resource control information elements

– *ConfiguredGrantConfig*

The IE *ConfiguredGrantConfig* is used to configure uplink transmission without dynamic grant according to two possible schemes. The actual uplink grant may either be configured via RRC (type1) or provided via the PDCCH (addressed to CS-RNTI) (type2).

[137]

[134] TS38.211 V15.10.0
[135] TS38.201 V15.0.0
[136] TS38.331 V15.3.0
[137] TS38.331 V15.3.0

| 7.3.1.2.1 Format 1_0 |
| --- |
| DCI format 1_0 is used for the scheduling of PDSCH in one DL cell. |
| The following information is transmitted by means of the DCI format 1_0 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI: |

[138]

| 7.3.1.2.2 Format 1_1 |
| --- |
| DCI format 1_1 is used for the scheduling of PDSCH in one cell. |
| The following information is transmitted by means of the DCI format 1_1 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI: |

[139]

227. For example, the Accused Products are UEs wherein the first radio signal is transmitted by K antenna port groups; the antenna port group includes a positive integer number of antenna port(s); a first antenna port group is one of the K antenna port groups. For example. the first radio signal (*e.g.*, CSI-RS or SS/PBCH) is transmitted by K antenna port groups of the base station. For example, the first radio signal comprises K CSI-RS resources / SS/PBCH block resources. The K antenna port groups correspond to the K CSI-RS resources / SS/PBCH block resources, respectively, with each antenna port group comprises one or more ports included in the corresponding CSI-RS resource / SS/PBCH block resources. The antenna port group includes a positive integer number of antenna port(s) (*e.g.*, number of ports). A first antenna port group (*e.g.*, one or more ports included in one CSI-RS or SS/PBCH) is one of the K antenna port groups.

| 5.1.6.1.1 CSI-RS for tracking |
| --- |
| A UE in RRC connected mode is expected to receive the higher layer UE specific configuration of a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info*. |
| For a *NZP-CSI-RS-ResourceSet* configured with the higher layer parameter *trs-Info*, the UE shall assume the antenna port with the same port index of the configured NZP CSI-RS resources in the *NZP-CSI-RS-ResourceSet* is the same. For frequency range 1, the UE may be configured with one or more NZP CSI-RS set(s), where a *NZP-CSI-RS-ResourceSet* consists of four periodic NZP CSI-RS resources in two consecutive slots with two periodic NZP CSI-RS resources in each slot. For frequency range 2 the UE may be configured with one or more NZP CSI-RS set(s), where a *NZP-CSI-RS-ResourceSet* consists of two periodic CSI-RS resources in one slot or with a *NZP-CSI-RS-ResourceSet* of four periodic NZP CSI-RS resources in two consecutive slots with two periodic NZP CSI-RS resources in each slot. |

[140]

[138] TS38.212 V15.2.0
[139] TS38.212 V15.2.0
[140] TS38.214 V15.3.0

### 5.2.1.2 Resource settings

Each Resource Setting *ResourceConfig* contains a configuration of S≥1 CSI-RS Resource Sets (higher layer parameter *ResourceSetConfig*), with each Resource Set consisting of CSI-RS resources (higher layer parameters *NZP-CSI-RS-ResourceConfigList* and *CSI-IM-ResourceConfigList)* and SS/PBCH Block resources used for L1-RSRP computation (higher layer parameter *resource-config-SS-list)*. Each Resource setting is located in the BWP identified by the higher layer parameter *BWP-info*, and all linked Resource Settings of a CSI Report Setting have the same BWP.

For periodic and semi-persistent CSI Resource Settings, S=1. Each set *s* contains $K_s \geq 1$ CSI-RS resources (higher layer parameter *CSI-RS-ResourceConfig*) each of which includes at least mapping to REs, number of ports and time-domain behavior as described in Subclause 5.2.2.3.1. The allowable antenna port values and resource mapping patterns are given in Subclause 7.4.1.5 of [4, TS 38.211]. The time domain behavior of the CSI-RS resources which are part of sets within a CSI-RS Resource Setting are indicated by the higher layer parameter *ResourceConfigType* and can be aperiodic, periodic, or semi-persistent. [141]

### 7.4.1.5 CSI reference signals

#### 7.4.1.5.1 General

Zero-power (ZP) and non-zero-power (NZP) CSI-RS are defined

- for a non-zero-power CSI-RS configured by the *NZP-CSI-RS-Resource* IE or by the *CSI-RS-Resource-Mobility* field in the *CSI-RS-ResourceConfigMobility* IE, the sequence shall be generated according to clause 7.4.1.5.2 and mapped to resource elements according to clause 7.4.1.5.3
- for a zero-power CSI-RS configured by the *ZP-CSI-RS-Resource* IE, the UE shall assume that the resource elements defined in clause 7.4.1.5.3 are not used for PDSCH transmission subject to clause 5.1.4.2 of [6, TS 38.214]. The UE performs the same measurement/reception on channels/signals except PDSCH regardless of whether they collide with ZP CSI-RS or not. [142]

A UE may be scheduled with a number of DM-RS ports by the antenna port index in DCI format 1_1 as described in Subclause 7.3.1.2 of [5, TS 38.212]. [143]

### 7.3.1.2 DCI formats for scheduling of PDSCH

#### 7.3.1.2.1 Format 1_0

DCI format 1_0 is used for the scheduling of PDSCH in one DL cell. [144]

| ***ConfiguredGrantConfig field descriptions*** |
|---|
| ***antennaPort*** |
| Indicates the antenna port(s) to be used for this configuration, and the maximum bitwidth is 5. See TS 38.214, section 6.1.2, and TS 38.212, section 7.3.1. |

[145]

[141] TS38.214 V15.0.0
[142] TS38.211 V15.10.0
[143] TS38.214 V15.3.0
[144] TS38.212 V15.2.0
[145] TS38.331 V15.3.0

### 7.3.1 DCI formats

The DCI formats defined in table 7.3.1-1 are supported.

**Table 7.3.1-1: DCI formats**

| DCI format | Usage |
|---|---|
| 0_0 | Scheduling of PUSCH in one cell |
| 0_1 | Scheduling of PUSCH in one cell |
| 1_0 | Scheduling of PDSCH in one cell |
| 1_1 | Scheduling of PDSCH in one cell |
| 2_0 | Notifying a group of UEs of the slot format |
| 2_1 | Notifying a group of UEs of the PRB(s) and OFDM symbol(s) where UE may assume no transmission is intended for the UE |
| 2_2 | Transmission of TPC commands for PUCCH and PUSCH |
| 2_3 | Transmission of a group of TPC commands for SRS transmissions by one or more UEs |

[146]

#### 5.1.1.1 Transmission scheme 1

For transmission scheme 1 of the PDSCH, the UE may assume that a gNB transmission on the PDSCH would be performed with up to 8 transmission layers on antenna ports 1000-1011 as defined in Subclause 7.3.1.4 of [4, TS 38.211], subject to the DM-RS reception procedures in Subclause 5.1.6.2.

### 5.1.2 Resource allocation

#### 5.1.2.1 Resource allocation in time domain

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value $m$ of the DCI provides a row index $m + 1$ to an allocation table. The determination of the used resource allocation table is defined in sub-clause 5.1.2.1.1. The indexed row defines the slot offset $K_0$, the start and length indicator $SLIV$, or directly the start symbol $S$ and the allocation length $L$, and the PDSCH mapping type to be assumed in the PDSCH reception.

[147]

***trs-Info***
Indicates that the antenna port for all NZP-CSI-RS resources in the CSI-RS resource set is same. If the field is absent or released the UE applies the value "false". Corresponds to L1 parameter 'TRS-Info' (see 38.214, section 5.2.2.3.1)

[148]

#### 5.2.2.3 Reference signal (CSI-RS)

##### 5.2.2.3.1 NZP CSI-RS

The UE can be configured with one or more NZP CSI-RS resource set configuration(s) as indicated by the higher layer parameters *CSI-ResourceConfig*, and *NZP-CSI-RS-ResourceSet*. Each NZP CSI-RS resource set consists of $K \geq 1$ NZP CSI-RS resource(s).

[149]

228. For example, the Accused Products are UEs wherein the first signaling is used to determine a first time resource pool. For example, the first time resource pool is the time domain

[146] TS38.212 V15.2.0
[147] TS38.214 V15.3.0
[148] TS38.331 V15.3.0
[149] TS38.214 V15.3.0

resource occupied by a search space set. In other examples, the first time resource pool is the time domain resource occupied by a PUSCH. In one example, the first signaling (*e.g.*, IE SearchSpace) is used to determine a first-time resource pool (*e.g.*, monitoringSlotPeriodicityAndOffset; monitoringSymbolsWithinSlot).

## 6.3.2 Radio resource control information elements

– *SearchSpace*

The IE *SearchSpace* defines how/where to search for PDCCH candidates. Each search space is associated with one *ControlResourceSet*.

***SearchSpace* information element**

```
-- ASN1START
-- TAG-SEARCHSPACE-START

SearchSpace ::=                         SEQUENCE {
    searchSpaceId                           SearchSpaceId,
    controlResourceSetId                    ControlResourceSetId                                    OPTIONAL,   -- Cond
SetupOnly
    monitoringSlotPeriodicityAndOffset      CHOICE {
        sl1                                     NULL,
        sl2                                     INTEGER (0..1),
        sl4                                     INTEGER (0..3),
        sl5                                     INTEGER (0..4),
        sl8                                     INTEGER (0..7),
        sl10                                    INTEGER (0..9),
        sl16                                    INTEGER (0..15),
        sl20                                    INTEGER (0..19),
        sl40                                    INTEGER (0..39),
        sl80                                    INTEGER (0..79),
        sl160                                   INTEGER (0..159),
        sl320                                   INTEGER (0..319),
        sl640                                   INTEGER (0..639),
        sl1280                                  INTEGER (0..1279),
        sl2560                                  INTEGER (0..2559)
    }                                                                                               OPTIONAL,   -- Cond Setup
    duration                                INTEGER (2..2559)                                       OPTIONAL,   -- Need R
    monitoringSymbolsWithinSlot             BIT STRING (SIZE (14))                                  OPTIONAL,   -- Cond Setup
```

[150]

229. In another example, the first signaling (*e.g.*, IE ConfiguredGrantConfig) is used to determine a first time resource pool (*e.g.*, timeDomainOffset; timeDomainAllocation).

## 6.3.2 Radio resource control information elements

– *ConfiguredGrantConfig*

The IE *ConfiguredGrantConfig* is used to configure uplink transmission without dynamic grant according to two possible schemes. The actual uplink grant may either be configured via RRC (type1) or provided via the PDCCH (addressed to CS-RNTI) (type2).

***ConfiguredGrantConfig* information element**

…

```
configuredGrantTimer                    INTEGER (1..64)                                         OPTIONAL,   -- Need R
rrc-ConfiguredUplinkGrant               SEQUENCE {
    timeDomainOffset                            INTEGER (0..5119),
    timeDomainAllocation                        INTEGER  (0..15),
    frequencyDomainAllocation               BIT STRING (SIZE(18)),
    antennaPort                             INTEGER (0..31),
    dmrs-SeqInitialization                  INTEGER (0..1)                                  OPTIONAL,   -- Need R
    precodingAndNumberOfLayers              INTEGER (0..63),
    srs-ResourceIndicator                   INTEGER (0..15)                                         OPTIONAL,   -- Need R
    mcsAndTBS                               INTEGER (0..31),
    frequencyHoppingOffset                  INTEGER (1.. maxNrofPhysicalResourceBlocks-1)   OPTIONAL,   -- Need R
    pathlossReferenceIndex                  INTEGER (0..maxNrofPUSCH-PathlossReferenceRSs-1),
```

[151]

[150] TS38.331 V15.3.0
[151] TS38.331 V15.3.0

230. For example, in another example, the first signaling (*e.g.*, DCI format 1_0; DCI format 1_1;) is used to determine a first time resource pool (*e.g.*, time domain resource assignment).

> **7.3.1.2.1 Format 1_0**
>
> DCI format 1_0 is used for the scheduling of PDSCH in one DL cell.
>
> The following information is transmitted by means of the DCI format 1_0 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI:

….

> - Time domain resource assignment – 4 bits as defined in Subclause 5.1.2.1 of [6, TS 38.214]

[152]

**5.1.2.1 Resource allocation in time domain**

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value $m$ of the DCI provides a row index $m + 1$ to an allocation table. The determination of the used resource allocation table is defined in sub-clause 5.1.2.1.1. The indexed row defines the slot offset $K_0$, the start and length indicator $SLIV$, or directly the start symbol $S$ and the allocation length $L$, and the PDSCH mapping type to be assumed in the PDSCH reception. [153]

> **7.3.1.2.2 Format 1_1**
>
> DCI format 1_1 is used for the scheduling of PDSCH in one cell.
>
> The following information is transmitted by means of the DCI format 1_1 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI:

…

> - Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Subclause 5.1.2.1 of [6, TS 38.214]. The bitwidth for this field is determined as $\lceil \log_2(I) \rceil$ bits, where $I$ is the number of entries in the higher layer parameter *pdsch-AllocationList*.

[154]

> **5.1.2.1 Resource allocation in time domain**
>
> When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value $m$ of the DCI provides a row index $m + 1$ to an allocation table. The determination of the used resource allocation table is defined in sub-clause 5.1.2.1.1. The indexed row defines the slot offset $K_0$, the start and length indicator $SLIV$, or directly the start symbol $S$ and the allocation length $L$, and the PDSCH mapping type to be assumed in the PDSCH reception.

[155]

---

[152] TS38.212 V15.2.0
[153] TS38.214 V15.3.0
[154] TS38.212 V15.2.0
[155] TS38.214 V15.3.0

231. For example, the Accused Products are UEs wherein a second antenna virtualization vector is associated with the first antenna port group; the second antenna virtualization vector is an antenna virtualization vector available to the user equipment in the first time resource pool; and the K is a positive integer greater than 1. For example. the selection of the receiving depends on, for example, the QCL obtained and, on the basis of that obtained QCL, a spatial Receive (Rx) parameter is used by the UE. For example, according to TS38.331 v15.3.0 – clause 6.3.2, a search space set is associated with a CORESET. According to D2 – clause 10.1, a TCI-state is configured for a CORESET, which indicates at least one RS(CSI-RS or SS/PBCH, *see* TS38.331 v15.3.0 clause 6.3.2) providing QCL information for PDCCH reception in this CORESET (i.e., in the associated search space set in the first time resource pool). The first antenna port group contains the port(s) of the RS indicated by the TCI state. According to the definition of QCL in TS 38.214 v15.3.0 – clause 5.1.5, the QCL information includes spatial Rx parameters. Spatial Rx parameters include Rx antenna virtualization vector. Therefore, the second antenna virtualization vector is associated with the first antenna port group. In another example, according to TS38.214 v15.3.0 – clause 5.1.5, when there is no TCI field in a DCI (*e.g.*, DCI format 1_0), a default TCI state is used for the PDSCH (i.e., in the first time resource pool). The first antenna port group contains port(s) of the RS indicated by the default TCI state. According to the definition of QCL in TS38.214 v15.3.0 – clause 5.1.5, the QCL information includes spatial Rx parameters. Spatial Rx parameters include Rx antenna virtualization vector. Therefore, the second antenna virtualization vector is associated with the first antenna port group. In another example, according to TS38.212 v15.2.0 – clause 7.3.1.2.2, a TCI (Transmission Configuration Indication) state is indicated in DCI format 1_1 for a PDSCH (*i.e.*, in the first time resource pool), which refers to a CSI-RS or SS/PBCH for QCL information. The first antenna port group contains port(s) of the RS

indicated by the TCI state. According to the definition of QCL in TS38.214 v15.3.0 – clause 5.1.5, the QCL information includes spatial Rx parameters. Spatial Rx parameters include the Rx antenna virtualization vector. Therefore, the second antenna virtualization vector is associated with the first antenna port group.

### 4.2.2 Physical channels and modulation

The physical channels defined in the downlink are:

- the Physical Downlink Shared Channel (PDSCH),
- the Physical Downlink Control Channel (PDCCH),
- the Physical Broadcast Channel (PBCH),

[156]

### 6.3.2 Radio resource control information elements

– *SearchSpace*

The IE *SearchSpace* defines how/where to search for PDCCH candidates. Each search space is associated with one *ControlResourceSet*.

***SearchSpace* information element**

```
-- ASN1START
-- TAG-SEARCHSPACE-START

SearchSpace ::=                     SEQUENCE {
    searchSpaceId                       SearchSpaceId,
    controlResourceSetId                ControlResourceSetId                    OPTIONAL,   -- Cond
SetupOnly
```

[157]

### 6.3.2 Radio resource control information elements

– *ConfiguredGrantConfig*

The IE *ConfiguredGrantConfig* is used to configure uplink transmission without dynamic grant according to two possible schemes. The actual uplink grant may either be configured via RRC (type1) or provided via the PDCCH (addressed to CS-RNTI) (type2).

***ConfiguredGrantConfig* information element**

…

```
configuredGrantTimer                INTEGER (1..64)                                     OPTIONAL,   -- Need R
rrc-ConfiguredUplinkGrant           SEQUENCE {
    timeDomainOffset                        INTEGER (0..5119),
    timeDomainAllocation                    INTEGER  (0..15),
    frequencyDomainAllocation           BIT STRING (SIZE(18)),
    antennaPort                         INTEGER (0..31),
    dmrs-SeqInitialization              INTEGER (0..1)                          OPTIONAL,   -- Need R
    precodingAndNumberOfLayers          INTEGER (0..63),
    srs-ResourceIndicator               INTEGER (0..15)                             OPTIONAL,   -- Need R
    mcsAndTBS                           INTEGER (0..31),
    frequencyHoppingOffset              INTEGER (1.. maxNrofPhysicalResourceBlocks-1)   OPTIONAL,   -- Need R
    pathlossReferenceIndex              INTEGER (0..maxNrofPUSCH-PathlossReferenceRSs-1),
```

[158]

[156] TS38.201 V15.0.0
[157] TS38.331 V15.3.0
[158] TS38.331 V15.3.0

### 5.1.5 Antenna ports quasi co-location

The UE can be configured with a list of up to *M TCI-State* configurations within the higher layer parameter *PDSCH-Config* to decode PDSCH according to a detected PDCCH with DCI intended for the UE and the given serving cell, where M depends on the UE capability. Each *TCI-State* contains parameters for configuring a quasi co-location relationship between one or two downlink reference signals and the DM-RS ports of the PDSCH. The quasi co-location relationship is configured by the higher layer parameter *qcl-Type1* for the first DL RS, and *qcl-Type2* for the second DL RS (if configured). For the case of two DL RSs, the QCL types shall not be the same, regardless of whether the references are to the same DL RS or different DL RSs. The quasi co-location types corresponding to each DL RS are given by the higher layer parameter *qcl-Type* in *QCL-Info* and may take one of the following values: [159]

#### 7.3.1.2.2 Format 1_1

DCI format 1_1 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1_1 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI:

…

- Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Subclause 5.1.2.1 of [6, TS 38.214]. The bitwidth for this field is determined as $\lceil \log_2(I) \rceil$ bits, where $I$ is the number of entries in the higher layer parameter *pdsch-AllocationList*. [160]

#### 5.1.2.1 Resource allocation in time domain

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value $m$ of the DCI provides a row index $m + 1$ to an allocation table. The determination of the used resource allocation table is defined in sub-clause 5.1.2.1.1. The indexed row defines the slot offset $K_0$, the start and length indicator *SLIV*, or directly the start symbol $S$ and the allocation length $L$, and the PDSCH mapping type to be assumed in the PDSCH reception. [161]

### 5.1.5 Antenna ports quasi co-location

The UE can be configured with a list of up to *M TCI-State* configurations within the higher layer parameter *PDSCH-Config* to decode PDSCH according to a detected PDCCH with DCI intended for the UE and the given serving cell, where M depends on the UE capability. Each *TCI-State* contains parameters for configuring a quasi co-location relationship between one or two downlink reference signals and the DM-RS ports of the PDSCH. The quasi co-location relationship is configured by the higher layer parameter *qcl-Type1* for the first DL RS, and *qcl-Type2* for the second DL RS (if configured). For the case of two DL RSs, the QCL types shall not be the same, regardless of whether the references are to the same DL RS or different DL RSs. The quasi co-location types corresponding to each DL RS are given by the higher layer parameter *qcl-Type* in *QCL-Info* and may take one of the following values:

- 'QCL-TypeA': {Doppler shift, Doppler spread, average delay, delay spread}
- 'QCL-TypeB': {Doppler shift, Doppler spread}
- 'QCL-TypeC': {Doppler shift, average delay}
- 'QCL-TypeD': {Spatial Rx parameter} [162]

## 6.3.2 Radio resource control information elements

[159] TS38.214 V15.3.0
[160] TS38.212 V15.2.0
[161] TS38.214 V15.3.0
[162] TS38.214 V15.3.0

– *TCI-State*

The IE *TCI-State* associates one or two DL reference signals with a corresponding quasi-colocation (QCL) type.

***TCI-State* information element**

```
-- ASN1START
-- TAG-TCI-STATE-START

TCI-State ::=                       SEQUENCE {
    tci-StateId                         TCI-StateId,
    qcl-Type1                           QCL-Info,
    qcl-Type2                           QCL-Info                                    OPTIONAL,   -- Need R
    ...
}

QCL-Info ::=                        SEQUENCE {
    cell                                ServCellIndex                               OPTIONAL,   -- Need R
    bwp-Id                              BWP-Id                                      OPTIONAL, -- Cond CSI-RS-Indicated
    referenceSignal                     CHOICE {
        csi-rs                              NZP-CSI-RS-ResourceId,
        ssb                                 SSB-Index
    },
    qcl-Type                            ENUMERATED {typeA, typeB, typeC, typeD},
    ...
}

-- TAG-TCI-STATE-STOP
-- ASN1STOP
```

[163]

> **5.1.6.1.1 CSI-RS for tracking**
>
> A UE in RRC connected mode is expected to receive the higher layer UE specific configuration of a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info*.
>
> For a *NZP-CSI-RS-ResourceSet* configured with the higher layer parameter *trs-Info*, the UE shall assume the antenna port with the same port index of the configured NZP CSI-RS resources in the *NZP-CSI-RS-ResourceSet* is the same. For frequency range 1, the UE may be configured with one or more NZP CSI-RS set(s), where a *NZP-CSI-RS-ResourceSet* consists of four periodic NZP CSI-RS resources in two consecutive slots with two periodic NZP CSI-RS resources in each slot. For frequency range 2 the UE may be configured with one or more NZP CSI-RS set(s), where a *NZP-CSI-RS-ResourceSet* consists of two periodic CSI-RS resources in one slot or with a *NZP-CSI-RS-ResourceSet* of four periodic NZP CSI-RS resources in two consecutive slots with two periodic NZP CSI-RS resources in each slot.

[164]

232. For example, the Accused Products are UEs wherein the first radio signal includes one or more of PSS (Primary Synchronization Signal), SSS (Secondary Synchronization Signal), MIB (Master Information Block)/SIB (System Information Block) or CSI-RS (Channel State Information Reference signal); the first signaling is a downlink signaling. For example, the Accused Products receive a first radio signal (*e.g.*, CSI-RS or SS/PBCH) and the first radio signal includes one or more of PSS (Primary Synchronization Signal), SSS (Secondary Synchronization Signal), MIB (Master Information Block)/SIB (System Information Block) or CSI-RS (Channel State Information Reference) and the first signaling received by Accused Products is basically downlink signaling.

[163] TS38.331 V15.3.0
[164] TS38.214 V15.3.0

## 5.1.6 UE procedure for receiving downlink reference signals

### 5.1.6.1 CSI-RS reception procedure

The CSI-RS defined in Subclause 7.4.1.5 of [4, TS 38.211], may be used for time/frequency tracking, CSI computation, L1-RSRP computation and mobility.

If the UE is configured with a CSI-RS resource and a search space set associated with a CORESET in the same OFDM symbol(s), the UE may assume that the CSI-RS and a PDCCH DM-RS transmitted in all the search space sets associated with CORESET are quasi co-located with 'QCL-TypeD', if 'QCL-TypeD' is applicable. Furthermore, the UE shall not expect to be configured with the CSI-RS in PRBs that overlap those of the CORESET in the OFDM symbols occupied by the search space set(s).

A UE in RRC connected mode is expected to receive the higher layer UE specific configuration of a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info*. [165]

## 5.1.6.1.2 CSI-RS for L1-RSRP computation

If the UE is configured with a *CSI-ReportConfig* with *reportQuantity* set to "cri-RSRP", or "none" and if the *CSI-ResourceConfig* for channel measurement (higher layer parameter *resourcesForChannelMeasurement*) contains a *NZP-CSI-RS-ResourceSet* that is configured with the higher layer parameter *repetition* and without the higher layer parameter *trs-Info*, the UE can only be configured with the same number (1 or 2) of ports with the higher layer parameter *nrofPorts* for all CSI-RS resources within the set. If the UE is configured with the CSI-RS resource in the same OFDM symbol(s) as an SS/PBCH block, the UE may assume that the CSI-RS and the SS/PBCH block are quasi co-located with 'QCL-TypeD' if 'QCL-TypeD' is applicable. Furthermore, the UE shall not expect to be configured with the CSI-RS in PRBs that overlap with those of the SS/PBCH block, and the UE shall expect that the same subcarrier spacing is used for both the CSI-RS and the SS/PBCH block. [166]

### 7.4.1.5 CSI reference signals

#### 7.4.1.5.1 General

Zero-power (ZP) and non-zero-power (NZP) CSI-RS are defined

- for a non-zero-power CSI-RS configured by the *NZP-CSI-RS-Resource* IE or by the *CSI-RS-Resource-Mobility* field in the *CSI-RS-ResourceConfigMobility* IE, the sequence shall be generated according to clause 7.4.1.5.2 and mapped to resource elements according to clause 7.4.1.5.3
- for a zero-power CSI-RS configured by the *ZP-CSI-RS-Resource* IE, the UE shall assume that the resource elements defined in clause 7.4.1.5.3 are not used for PDSCH transmission subject to clause 5.1.4.2 of [6, TS 38.214]. The UE performs the same measurement/reception on channels/signals except PDSCH regardless of whether they collide with ZP CSI-RS or not. [167]

### 5.2.5.5 Reception of SIB1

The Master Information Block (MIB) on PBCH provides the UE with parameters (e.g. CORESET#0 configuration) for monitoring of PDCCH for scheduling PDSCH that carries the System Information Block 1 (SIB1). PBCH may also indicate that there is no associated SIB1, in which case the UE may be pointed to another frequency from where to search for an SSB that is associated with a SIB1 as well as a frequency range where the UE may assume no SSB associated with SIB1 is present. The indicated frequency range is confined within a contiguous spectrum allocation of the same operator in which SSB is detected. [168]

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[165] TS38.214 V15.3.0
[166] TS38.214 V15.3.0
[167] TS38.211 V15.10.0
[168] TS38.300 V15.8.0

#### 5.2.5.1 Link adaptation

Link adaptation (AMC: adaptive modulation and coding) with various modulation schemes and channel coding rates is applied to the PDSCH. The same coding and modulation is applied to all groups of resource blocks belonging to the same L2 PDU scheduled to one user within one transmission duration and within a MIMO codeword.

For channel state estimation purposes, the UE may be configured to measure CSI-RS and estimate the downlink channel state based on the CSI-RS measurements. The UE feeds the estimated channel state back to the gNB to be used in link adaptation. [169]

### 5.2.4 Synchronization signal and PBCH block

The Synchronization Signal and PBCH block (SSB) consists of primary and secondary synchronization signals (PSS, SSS), each occupying 1 symbol and 127 subcarriers, and PBCH spanning across 3 OFDM symbols and 240 subcarriers, but on one symbol leaving an unused part in the middle for SSS as show in Figure 5.2.4-1. The possible time locations of SSBs within a half-frame are determined by sub-carrier spacing and the periodicity of the half-frames where SSBs are transmitted is configured by the network. During a half-frame, different SSBs may be transmitted in different spatial directions (i.e. using different beams, spanning the coverage area of a cell). [170]

## 7.3 Downlink control information

A DCI transports downlink control information for one or more cells with one RNTI. [171]

233. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’110 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant’s customers and end-users, in this District and elsewhere in the United States. For example, Defendant’s customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the ’110 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[172] Because of Defendant’s inducement,

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[169] TS38.300 V15.8.0
[170] TS38.300 V15.8.0
[171] TS38.212 V15.2.0
[172] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad;

Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '110 Patent. Defendant performs these affirmative acts with knowledge of the '110 Patent and with the intent, or willful blindness, that the induced acts directly infringe the '110 Patent.

234. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '110 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant's affirmative acts of selling and offering to sell the Accused Products in this District and elsewhere in the United States and causing the Accused Products to be manufactured, used, sold, and offered for sale contributes to others' use and manufacture of the Accused Products such that the '110 Patent is directly infringed by others. The accused components within the Accused Products including, but not limited to, chipsets manufactured by Defendant, are material to the invention of the '110 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the '110 Patent. Defendant performs these affirmative acts with knowledge of the '110 Patent and with intent, or willful blindness, that they cause the direct infringement of the '110 Patent.

235. ABT has suffered damages as a result of Defendant's direct and indirect infringement of the '110 Patent in an amount to be proved at trial.

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https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

236. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant's infringement of the '110 Patent, for which there is no adequate remedy at law, unless Defendant's infringement is enjoined by this Court.

237. On information and belief, Defendant acted egregiously and with willful misconduct in that their actions constituted direct or indirect infringement of a valid patent, and this was either known or so obvious that Defendant should have known about it. Defendant continue to infringe the '110 Patent by making, using, selling, offering for sale and/or importing in the United States the Accused Products and by inducing the direct infringing use, sale, offer for sale, and importation of the Accused Products by others, in reckless disregard of ABT's patent rights. Defendant has committed and continues to commit acts of infringement that Defendant actually knew or should have known constituted an unjustifiably high risk of infringement of at least one valid and enforceable claim of the '110 Patent. Upon information and belief, Defendant had actual knowledge of the '110 Patent from related prior litigations accusing either the same products involving Defendant and products with similar 5G functionalities involving direct competitors of Defendant. Defendant's infringement of the '110 Patent has been and continues to be willful, entitling ABT to an award of treble damages, reasonable attorney fees, and costs in bringing this action under 35 U.S.C. §§ 284 and 285.

## COUNT XII
## (Infringement of the '904 Patent)

238. The preceding paragraphs are incorporated by reference as if fully set forth herein.

239. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the '904 Patent.

240. Defendant has and continues to directly infringe the '904 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making,

using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the ’904 Patent. Such products include at least Accused Products including, but not limited to, Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which are each a user equipment (UE) for multi-antenna transmission comprising: a first receiver, receiving a first signaling; a second receiver, receiving a first wireless signal; and a third transmitter, transmitting first information; wherein, K antenna port groups are used to transmit the first wireless signal; the first signaling is used to determine the K antenna port groups transmitting the first wireless signal; the K is a positive integer greater than 1; the K antenna port groups respectively correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference Signal Received Powers (RSRPs) or Signal to Interference plus Noise Ratios (SINRs); K1 antenna port groups of the K antenna port groups correspond to K1 channel quality values of the K channel quality values; the K1 is a positive integer less than or equal to the K; a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values; the first information is used to determine the K1 antenna port groups and the first proportional sequence; the first signaling is used to determine a target threshold; the target threshold is a non-negative real number; a first channel quality is a best channel quality value among the K1 channel quality values; a second channel quality is a worse channel quality value among the K1 channel quality values; a ratio between the second channel quality and the first

channel quality is greater than or equal to the target threshold; the first signaling is a RRC (Radio Resource Control) signaling; the first information is transmitted in a CSI (Channel State Information) report; the first information is carried by a PUSCH (Physical Uplink Shared Channel) or a PUCCH (Physical Uplink Control Channel).

241. For example, Defendant has and continues to directly infringe at least claim 11 of the '904 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards such as the Accused Products (*e.g.*, 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware for implementing 3rd Generation Partnership Product (3GPP) specifications).

242. For example, the Accused Products comprise a first receiver, receiving a first signaling and a second receiver, receiving a first wireless signal. For example, the Accused Products receive a first signaling (e.g., RRC signaling) comprising CSI-ReportConfig IE, CSI-ResourceConfig IE, CSI-AperiodicTriggerStateList, CSI-SemiPersistentOnPUSCH-TriggerStateList) from the higher layer (i.e., through RRC Configuration) and provides UE a set of CSI RS resources for Channel (*i.e.*, a first wireless signal) through CSI-ResourceConfig IE. These CSI RS resources are Periodic, Semi-persistent and/or Aperiodic.

> **5.2.1 Channel state information framework**
>
> The time and frequency resources that can be used by the UE to report CSI are controlled by the gNB. CSI may consist of Channel Quality Indicator (CQI), precoding matrix indicator (PMI), CSI-RS resource indicator (CRI), SS/PBCH Block Resource indicator (SSBRI), layer indicator (LI), rank indicator (RI) and/or L1-RSRP.
>
> For CQI, PMI, CRI, SSBRI, LI, RI, L1-RSRP, a UE is configured by higher layers with N≥1 *CSI-ReportConfig* Reporting Settings, M≥1 *CSI-ResourceConfig* Resource Settings, and one or two list(s) of trigger states (given by the higher layer parameters *CSI-AperiodicTriggerStateList* and *CSI-SemiPersistentOnPUSCH-TriggerStateList*). Each trigger state in *CSI-AperiodicTriggerStateList* contains a list of associated *CSI-ReportConfigs* indicating the Resource Set IDs for channel and optionally for interference. Each trigger state in *CSI-SemiPersistentOnPUSCH-TriggerStateList* contains one associated *CSI-ReportConfig*.

[173]

[173] TS 38.214 V15.3.0

### 5.2.2.3 Reference signal (CSI-RS)

#### 5.2.2.3.1 NZP CSI-RS

The UE can be configured with one or more NZP CSI-RS resource set configuration(s) as indicated by the higher layer parameters *CSI-ResourceConfig,* and *NZP-CSI-RS-ResourceSet*. Each NZP CSI-RS resource set consists of $K \geq 1$ NZP CSI-RS resource(s).

The following parameters for which the UE shall assume non-zero transmission power for CSI-RS resource are configured via the higher layer parameter *NZP-CSI-RS-Resource* for each CSI-RS resource configuration:

- *nzp-CSI-RS-ResourceId* determines CSI-RS resource configuration identity.
- *periodicityAndOffset* defines the CSI-RS periodicity and slot offset for periodic/semi-persistent CSI-RS. All the CSI-RS resources within one set are configured with the same periodicity, while the slot offset can be same or different for different CSI-RS resources.
- *CSI-RS-resourceMapping* defines the number of ports, CDM-type, and OFDM symbol and subcarrier occupancy of the CSI-RS resource within a slot that are given in Subclause 7.4.1.5 of [4, TS 38.211].
- *nrofPorts* in *CSI-RS-ResourceMapping* defines the number of CSI-RS ports, where the allowable values are given in Subclause 7.4.1.5 of [4, TS 38.211]. [174]

### 7.4.1.5 CSI reference signals

#### 7.4.1.5.1 General

Zero-power (ZP) and non-zero-power (NZP) CSI-RS are defined

- for a non-zero-power CSI-RS configured by the *NZP-CSI-RS-Resource* IE or by the *CSI-RS-Resource-Mobility* field in the *CSI-RS-ResourceConfigMobility* IE, the sequence shall be generated according to clause 7.4.1.5.2 and mapped to resource elements according to clause 7.4.1.5.3
- for a zero-power CSI-RS configured by the *ZP-CSI-RS-Resource* IE, the UE shall assume that the resource elements defined in clause 7.4.1.5.3 are not used for PDSCH transmission. The UE performs the same measurement/reception on channels/signals except PDSCH regardless of whether they collide with ZP CSI-RS or not. [175]

#### 5.2.1.5.2 Semi-persistent CSI/Semi-persistent CSI-RS

For semi-persistent reporting on PUSCH, a set of trigger states are higher layer configured by *CSI-SemiPersistentOnPUSCH-TriggerStateList,* where the CSI request field in DCI scrambled with SP-CSI-RNTI activates one of the trigger states. For semi-persistent reporting on PUCCH, the PUCCH resource used for transmitting the CSI report are configured by *reportConfigType*. A UE is not expected to receive a DCI scrambled with SP-CSI-RNTI activating one semi-persistent CSI report with the same CSI-ReportConfigId as in a semi-persistent CSI report which is activated by a previously received DCI scrambled with SP-CSI-RNTI. [176]

[174] TS 38.214 V15.3.0
[175] TS 38.211 V15.3.0
[176] TS 38.214 V15.3.0

– *CSI-SemiPersistentOnPUSCH-TriggerStateList*

The *CSI-SemiPersistentOnPUSCH-TriggerStateList* IE is used to configure the UE with list of trigger states for semi-persistent reporting of channel state information on L1. See also 38.214, section 5.2.

***CSI-SemiPersistentOnPUSCH-TriggerStateList* information element**

```
-- ASN1START
-- TAG-CSI-SEMIPERSISTENTONPUSCHTRIGGERSTATELIST-START

CSI-SemiPersistentOnPUSCH-TriggerStateList ::=  SEQUENCE(SIZE (1..maxNrOfSemiPersistentPUSCH-Triggers)) OF CSI-SemiPersistentOnPUSCH-TriggerState

CSI-SemiPersistentOnPUSCH-TriggerState ::=      SEQUENCE {
    associatedReportConfigInfo                      CSI-ReportConfigId,
    ...
}


-- TAG-CSI-SEMIPERSISTENTONPUSCHTRIGGERSTATELIST-STOP
-- ASN1STOP
```

[177]

– *CSI-ReportConfig*

The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent on PUSCH triggered by DCI received on the cell in which the CSI-ReportConfig is included (in this case, the cell on which the report is sent is determined by the received DCI). See 38.214, section 5.2.1.

***CSI-ReportConfig* information element**

```
-- ASN1START
-- TAG-CSI-REPORTCONFIG-START

CSI-ReportConfig ::=                SEQUENCE {
```

***ETSI***

[178]

```
reportConfigId                          CSI-ReportConfigId,
carrier                                 ServCellIndex                   OPTIONAL,   -- Need S
resourcesForChannelMeasurement          CSI-ResourceConfigId,
csi-IM-ResourcesForInterference         CSI-ResourceConfigId        OPTIONAL,   -- Need R
nzp-CSI-RS-ResourcesForInterference     CSI-ResourceConfigId        OPTIONAL,   -- Need R
reportConfigType                        CHOICE {
    periodic                                SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUCCH                   SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUSCH                   SEQUENCE {
        reportSlotConfig                        ENUMERATED {sl5, sl10, sl20, sl40, sl80, sl160, sl320},
        reportSlotOffsetList                SEQUENCE (SIZE (1.. maxNrofUL-Allocations)) OF INTEGER(0..32),
        p0alpha                                 P0-PUSCH-AlphaSetId
    },
    aperiodic                               SEQUENCE {
        reportSlotOffsetList                SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)
    }
},
```

[179]

***resourcesForChannelMeasurement***
Resources for channel measurement. csi-ResourceConfigId of a CSI-ResourceConfig included in the configuration of the serving cell indicated with the field "carrier" above. The CSI-ResourceConfig indicated here contains only NZP-CSI-RS resources and/or SSB resources. This CSI-ReportConfig is associated with the DL BWP indicated by bwp-Id in that CSI-ResourceConfig.

[180]

## 5.2.3 CSI reporting using PUSCH

A UE shall perform aperiodic CSI reporting using PUSCH on serving cell c upon successful decoding of a DCI format 0_1 which triggers an aperiodic CSI trigger state.

[181]

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[177] TS 38.331 V15.3.0
[178] *Id.*
[179] *Id.*
[180] *Id.*
[181] *Id.*

### 5.2.1.5.1 Aperiodic CSI Reporting/Aperiodic CSI-RS

For CSI-RS resource sets associated with Resource Settings configured with the higher layer parameter *resourceType* set to 'aperiodic', periodic', or semi-persistent', trigger states for Reporting Setting(s) (configured with the higher layer parameter *reportConfigType* set to 'aperiodic') and/or Resource Setting for channel and/or interference measurement on one or more component carriers are configured using the higher layer parameter *CSI-AperiodicTriggerStateList*. For aperiodic CSI report triggering, a single set of CSI triggering states are higher layer configured, wherein the CSI triggering states can be associated with any candidate DL BWP. A UE is not expected to receive more than one DCI with non-zero CSI request per slot. A UE is not expected to receive more than one aperiodic CSI report request for transmission in a given slot. A UE is not expected to be triggered with a CSI report for a non-active DL BWP. A trigger state is initiated using the *CSI request* field in DCI.

[182]

– *CSI-AperiodicTriggerStateList*

The *CSI-AperiodicTriggerStateList* IE is used to configure the UE with a list of aperiodic trigger states. Each codepoint of the DCI field "CSI request" is associated with one trigger state. Upon reception of the value associated with a trigger state, the UE will perform measurement of CSI-RS (reference signals) and aperiodic reporting on L1 according to all entries in the *associatedReportConfigInfoList* for that trigger state.

***CSI-AperiodicTriggerStateList* information element**

```
-- ASN1START
-- TAG-CSI-APERIODICTRIGGERSTATELIST-START

CSI-AperiodicTriggerStateList ::=   SEQUENCE (SIZE (1..maxNrOfCSI-AperiodicTriggers)) OF CSI-AperiodicTriggerState

CSI-AperiodicTriggerState ::=       SEQUENCE {
    associatedReportConfigInfoList      SEQUENCE (SIZE(1..maxNrofReportConfigPerAperiodicTrigger)) OF CSI-AssociatedReportConfigInfo,
    ...
}

CSI-AssociatedReportConfigInfo ::=      SEQUENCE {
    reportConfigId                      CSI-ReportConfigId,
    resourcesForChannel                 CHOICE {
        nzp-CSI-RS                          SEQUENCE {
            resourceSet                         INTEGER (1..maxNrofNZP-CSI-RS-ResourceSetsPerConfig),
            qcl-info                            SEQUENCE (SIZE(1..maxNrofAP-CSI-RS-ResourcesPerSet)) OF TCI-StateId OPTIONAL        -- Cond
Aperiodic
        },
        csi-SSB-ResourceSet                 INTEGER (1..maxNrofCSI-SSB-ResourceSetsPerConfig)
    },
    csi-IM-ResourcesForInterference     INTEGER(1..maxNrofCSI-IM-ResourceSetsPerConfig)         OPTIONAL, -- Cond CSI-IM-ForInterference
    nzp-CSI-RS-ResourcesForInterference INTEGER (1..maxNrofNZP-CSI-RS-ResourceSetsPerConfig)        OPTIONAL, -- Cond NZP-CSI-RS-ForInterference
    ...
}

-- TAG-CSI-APERIODICTRIGGERSTATELIST-STOP
-- ASN1STOP
```

**183**

***reportConfigId***
The reportConfigId of one of the CSI-ReportConfigToAddMod configured in CSI-MeasConfig

[184]

– *CSI-ReportConfig*

The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent on PUSCH triggered by DCI received on the cell in which the CSI-ReportConfig is included (in this case, the cell on which the report is sent is determined by the received DCI). See 38.214, section 5.2.1.

***CSI-ReportConfig* information element**

```
-- ASN1START
-- TAG-CSI-REPORTCONFIG-START

CSI-ReportConfig ::=                SEQUENCE {
```

***ETSI***

[185]

[182] *Id.*
[183] TS 38.331 V15.3.0
[184] *Id.*
[185] *Id.*

```
reportConfigId                          CSI-ReportConfigId,
carrier                                 ServCellIndex                   OPTIONAL,   -- Need S
resourcesForChannelMeasurement          CSI-ResourceConfigId,
csi-IM-ResourcesForInterference         CSI-ResourceConfigId        OPTIONAL,   -- Need R
nzp-CSI-RS-ResourcesForInterference     CSI-ResourceConfigId        OPTIONAL,   -- Need R
reportConfigType                        CHOICE {
    periodic                                SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUCCH                   SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUSCH                   SEQUENCE {
        reportSlotConfig                        ENUMERATED {sl5, sl10, sl20, sl40, sl80, sl160, sl320},
        reportSlotOffsetList                SEQUENCE (SIZE (1.. maxNrofUL-Allocations)) OF INTEGER(0..32),
        p0alpha                                 P0-PUSCH-AlphaSetId
    },
    aperiodic                               SEQUENCE {
        reportSlotOffsetList                SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)
    }
},
```

186

***resourcesForChannelMeasurement***
Resources for channel measurement. csi-ResourceConfigId of a CSI-ResourceConfig included in the configuration of the serving cell indicated with the field "carrier" above. The CSI-ResourceConfig indicated here contains only NZP-CSI-RS resources and/or SSB resources. This CSI-ReportConfig is associated with the DL BWP indicated by bwp-Id in that CSI-ResourceConfig.

187

243. For example, the Accused Products comprise a third transmitter, transmitting first information. For example, Defendant and the Accused Products practice wherein the channel state information report is transmitted either via the physical uplink control channel (PUCCH) for periodic/semi-persistent CSI reporting, or through the physical uplink shared channel (PUSCH) for aperiodic CSI reporting. The transmitted channel state information report comprises of several channel quality values including L1-RSRP (*i.e.*, first information).

### 5.2.1 Channel state information framework

The time and frequency resources that can be used by the UE to report CSI are controlled by the gNB. CSI may consist of Channel Quality Indicator (CQI), precoding matrix indicator (PMI), CSI-RS resource indicator (CRI), SS/PBCH Block Resource indicator (SSBRI), layer indicator (LI), rank indicator (RI) and/or L1-RSRP.

For CQI, PMI, CRI, SSBRI, LI, RI, L1-RSRP, a UE is configured by higher layers with N≥1 *CSI-ReportConfig* Reporting Settings, M≥1 *CSI-ResourceConfig* Resource Settings, and one or two list(s) of trigger states (given by the higher layer parameters *CSI-AperiodicTriggerStateList* and *CSI-SemiPersistentOnPUSCH-TriggerStateList*). Each trigger state in *CSI-AperiodicTriggerStateList* contains a list of associated *CSI-ReportConfigs* indicating the Resource Set IDs for channel and optionally for interference. Each trigger state in *CSI-SemiPersistentOnPUSCH-TriggerStateList* contains one associated *CSI-ReportConfig*.

188

[186] *Id.*
[187] *Id.*
[188] TS 38.214 V15.3.0

#### 5.2.1.1 Reporting settings

Each Reporting Setting *CSI-ReportConfig* is associated with a single downlink BWP (indicated by higher layer parameter *bwp-Id*) given in the associated *CSI-ResourceConfig* for channel measurement and contains the parameter(s) for one CSI reporting band:codebook configuration including codebook subset restriction, time-domain behavior, frequency granularity for CQI and PMI, measurement restriction configurations, and the CSI-related quantities to be reported by the UE such as the layer indicator (LI), L1-RSRP, CRI, and SSBRI (SSB Resource Indicator). **189**

### 5.2.4 CSI reporting using PUCCH

A UE is semi-statically configured by higher layers to perform periodic CSI Reporting on the PUCCH. A UE can be configured by higher layers for multiple periodic CSI Reports corresponding to multiple higher layer configured CSI Reporting Settings, where the associated CSI Resource Settings are higher layer configured. Periodic CSI reporting on PUCCH formats 2, 3, 4 supports Type I CSI with wideband granularity.

A UE shall perform semi-persistent CSI reporting on the PUCCH applied starting from slot $n + 3N_{slot}^{subframe,\mu} + 1$ after the HARQ-ACK corresponding to the PDSCH carrying the selection command [10, TS 38.321] is transmitted in slot *n*. The selection command will contain one or more Reporting Settings where the associated CSI Resource Settings are configured. Semi-persistent CSI reporting on the PUCCH supports Type I CSI. Semi-persistent CSI reporting on the PUCCH format 2 supports Type I CSI with wideband frequency granularity. Semi-persistent CSI reporting on PUCCH formats 3 or 4 supports Type I CSI with wideband and sub-band frequency granularities and Type II CSI Part 1. **190**

### 5.2.3 CSI reporting using PUSCH

A UE shall perform aperiodic CSI reporting using PUSCH on serving cell c upon successful decoding of a DCI format 0_1 which triggers an aperiodic CSI trigger state. 191

#### 5.2.1.4.2 Report Quantity Configurations

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RSRP', 'cri-RI-PMI-CQI ', 'cri-RI-i1', 'cri-RI-i1-CQI', 'cri-RI-CQI' or 'cri-RI-LI-PMI-CQI', and $K_s > 1$ resources are configured in the corresponding resource set for channel measurement, then the UE shall derive the CSI parameters other than CRI conditioned on the reported CRI, where CRI $k$ ($k \geq 0$) corresponds to the configured ($k$+1)-th entry of associated *nzp-CSI-RSResource* in the corresponding *nzp-CSI-RS-ResourceSet* for channel measurement, and ($k$+1)-th entry of associated *csi-IM-Resource* in the corresponding *csi-IM-ResourceSet* (if configured) If $K_s = 2$ CSI-RS resources are configured, each resource shall contain at most 16 CSI-RS ports. If $2 < K_s \leq 8$ CSI-RS resources are configured, each resource shall contain at most 8 CSI-RS ports. **192**

```
reportQuantity                          CHOICE {
    none                                    NULL,
    cri-RI-PMI-CQI                          NULL,
    cri-RI-i1                               NULL,
    cri-RI-i1-CQI                           SEQUENCE {
        pdsch-BundleSizeForCSI                  ENUMERATED {n2, n4}     OPTIONAL    -- Need S
    },
    cri-RI-CQI                              NULL,
    cri-RSRP                                NULL,
    ssb-Index-RSRP                          NULL,
    cri-RI-LI-PMI-CQI                       NULL
```
193

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189 *Id.*
190 *Id.*
191 *Id.*
192 *Id.*
193 TS 38.331 V15.3.0

244. For example, the Accused Products are each a UE wherein K antenna port groups are used to transmit the first wireless signal; the first signaling is used to determine the K antenna port groups transmitting the first wireless signal; the K is a positive integer greater than 1; the K antenna port groups respectively correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference Signal Received Powers (RSRPs) or Signal to Interference plus Noise Ratios (SINRs). For example. Defendant and Accused Products practice wherein the CSI-RS (*i.e.*, first wireless signal), which is used for computing the CSI report including the L1-RSRP, is transmitted by one or more (*i.e.*, K, where the K is a positive integer greater than 1) quasi-co-located (QCLed) antenna port groups. The CSI-ReportConfig (*i.e.*, first signaling) is used to provide the antenna port mapping for the transmitted CSI-RS resources (*i.e.*, determine the K antenna port groups transmitting the first wireless signal). The CSI-ReportConfig specifies the CSI-RS resources, transmitted by one or more quasi-co-located (QCLed) antenna port groups, via CSI-ResourceConfigID, for which channel quality values including L1-RSRP are to be computed. Subsequently, the channel quality values, including L1-RSRP (*i.e.*, the K channel quality values are Reference Signal Received Powers (RSRPs) or Signal to Interference plus Noise Ratios (SINRs)), are calculated for each CSI-RS resource as per the specification of the CSI-ReportConfig (the K antenna port groups respectively correspond to K channel quality values;).

5.1.6.1 CSI-RS reception procedure

The CSI-RS defined in Subclause 7.4.1.5 of [4, TS 38.211], may be used for time/frequency tracking, CSI computation, L1-RSRP computation and mobility. [194]

[194] TS 38.214 V15.3.0

5.1.6.1.2 CSI-RS for L1-RSRP computation

If a UE is configured with a *NZP-CSI-RS-ResourceSet* configured with the higher layer parameter *repetition* set to 'on', the UE may assume that the CSI-RS resources, described in Subclause 5.2.2.3.1, within the *NZP-CSI-RS-ResourceSet* are transmitted with the same downlink spatial domain transmission filter, where the CSI-RS resources in the *NZP-CSI-RS-ResourceSet* are transmitted in different OFDM symbols. If *repetition* is set to 'off', the UE shall not assume that the CSI-RS resources within the *NZP-CSI-RS-ResourceSet* are transmitted with the same downlink spatial domain transmission filter.

If the UE is configured with a *CSI-ReportConfig* with *reportQuantity* set to "cri-RSRP", or "none" and if the *CSI-ResourceConfig* for channel measurement (higher layer parameter *resourcesForChannelMeasurement*) contains a *NZP-CSI-RS-ResourceSet* that is configured with the higher layer parameter *repetition* and without the higher layer parameter *trs-Info*, the UE can only be configured with the same number (1 or 2) of ports with the higher layer parameter *nrofPorts* for all CSI-RS resources within the set. If the UE is configured with the CSI-RS resource in the same OFDM symbol(s) as an SS/PBCH block, the UE may assume that the CSI-RS and the SS/PBCH block are quasi co-located with 'QCL-TypeD' if 'QCL-TypeD' is applicable. Furthermore, the UE shall not expect to be configured with the CSI-RS in PRBs that overlap with those of the SS/PBCH block, and the UE shall expect that the same subcarrier spacing is used for both the CSI-RS and the SS/PBCH block. [195]

**Source:** TS 138 214 - V15.3.0 - 5G; NR; Physical layer procedures for data (3GPP TS 38.214 version 15.3.0 Release 15) (etsi.org), Page 30.

5.2.1.2 Resource settings

Each Resource Setting *ResourceConfig* contains a configuration of S≥1 CSI-RS Resource Sets (higher layer parameter *ResourceSetConfig*), with each Resource Set consisting of CSI-RS resources (higher layer parameters *NZP-CSI-RS-ResourceConfigList* and *CSI-IM-ResourceConfigList)* and SS/PBCH Block resources used for L1-RSRP computation (higher layer parameter *resource-config-SS-list)*. Each Resource setting is located in the BWP identified by the higher layer parameter *BWP-info*, and all linked Resource Settings of a CSI Report Setting have the same BWP.

For periodic and semi-persistent CSI Resource Settings, S=1. Each set *s* contains $K_s \geq 1$ CSI-RS resources (higher layer parameter *CSI-RS-ResourceConfig*) each of which includes at least mapping to REs, number of ports and time-domain behavior as described in Subclause 5.2.2.3.1. The allowable antenna port values and resource mapping patterns are given in Subclause 7.4.1.5 of [4, TS 38.211]. The time domain behavior of the CSI-RS resources which are part of sets within a CSI-RS Resource Setting are indicated by the higher layer parameter *ResourceConfigType* and can be aperiodic, periodic, or semi-persistent. [196]

**Source:** TS 138 214 - V15.3.0 - 5G; NR; Physical layer procedures for data (3GPP TS 38.214 version 15.3.0 Release 15) (etsi.org), Page 35.

The UE shall assume that a CSI-RS is transmitted using antenna ports $p$ numbered according to

$$p = 3000 + s + jL;$$
$$j = 0,1,\ldots,N/L-1$$
$$s = 0,1,\ldots,L-1;$$

[197]

**Source:** TS 138 211 - V15.3.0 - 5G; NR; Physical channels and modulation (3GPP TS 38.211 version 15.3.0 Release 15) (etsi.org), Page 91.

[195] *Id.*
[196] *Id.*
[197] TS 38.211 V15.3.0

where $s$ is the sequence index provided by Tables 7.4.1.5.3-2 to 7.4.1.5.3-5, $L \in \{1,2,4,8\}$ is the CDM group size, and $N$ is the number of CSI-RS ports. The CDM group index $j$ given in Table 7.4.1.5.3-1 corresponds to the time/frequency locations $(\bar{k},\bar{l})$ for a given row of the table. The CDM groups are numbered in order of increasing frequency domain allocation first and then increasing time domain allocation. For a CSI-RS resource configured as periodic or semi-persistent by the higher-layer parameter *resourceType*, the UE shall assume that the CSI-RS is transmitted in slots satisfying

$$\left(N_{\text{slot}}^{\text{frame},\mu} n_{\text{f}} + n_{\text{s,f}}^{\mu} - T_{\text{offset}}\right) \bmod T_{\text{CSI-RS}} = 0$$

[198]

**Source: Source:** TS 138 211 - V15.3.0 - 5G; NR; Physical channels and modulation (3GPP TS 38.211 version 15.3.0 Release 15) (etsi.org), Page 91.

### 5.2.1.1 Reporting settings

Each Reporting Setting *CSI-ReportConfig* is associated with a single downlink BWP (indicated by higher layer parameter *bwp-Id*) given in the associated *CSI-ResourceConfig* for channel measurement and contains the parameter(s) for one CSI reporting band:codebook configuration including codebook subset restriction, time-domain behavior, frequency granularity for CQI and PMI, measurement restriction configurations, and the CSI-related quantities to be reported by the UE such as the layer indicator (LI), L1-RSRP, CRI, and SSBRI (SSB Resource Indicator).

The time domain behavior of the *CSI-ReportConfig* is indicated by the higher layer parameter *reportConfigType* and can be set to 'aperiodic', 'semiPersistentOnPUCCH', 'semiPersistentOnPUSCH', or 'periodic'. For periodic and semiPersistentOnPUCCH/semiPersistentOnPUSCH CSI reporting, the configured periodicity and slot offset applies in the numerology of the UL BWP in which the CSI report is configured to be transmitted on. The higher layer parameter *reportQuantity* indicates the CSI-related or L1-RSRP-related quantities to report. The *reportFreqConfiguration* indicates the reporting granularity in the frequency domain, including the CSI reporting band and if PMI/CQI reporting is wideband or sub-band. The *timeRestrictionForChannelMeasurements* parameter in *CSI-ReportConfig* can be configured to enable time domain restriction for channel measurements and *timeRestrictionForInterferenceMeasurements* can be configured to enable time domain restriction for interference measurements. The *CSI-ReportConfig* can also contain *CodebookConfig*, which contains configuration parameters for Type-I or Type II CSI including codebook subset restriction, and configurations of group based reporting.

[199]

– *CSI-ReportConfig*

The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent on PUSCH triggered by DCI received on the cell in which the CSI-ReportConfig is included (in this case, the cell on which the report is sent is determined by the received DCI). See 38.214, section 5.2.1.

**CSI-ReportConfig information element**

```
-- ASN1START
-- TAG-CSI-REPORTCONFIG-START

CSI-ReportConfig ::=                SEQUENCE {
```

ETSI

[200]

[198] *Id.*
[199] TS 38.214 V15.3.0
[200] TS 38.331 V15.3.0

```
reportConfigId                          CSI-ReportConfigId,
carrier                                 ServCellIndex                   OPTIONAL,   -- Need S
resourcesForChannelMeasurement          CSI-ResourceConfigId,
csi-IM-ResourcesForInterference         CSI-ResourceConfigId        OPTIONAL,   -- Need R
nzp-CSI-RS-ResourcesForInterference     CSI-ResourceConfigId        OPTIONAL,   -- Need R
reportConfigType                        CHOICE {
    periodic                                SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUCCH                   SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUSCH                   SEQUENCE {
        reportSlotConfig                        ENUMERATED {sl5, sl10, sl20, sl40, sl80, sl160, sl320},
        reportSlotOffsetList                SEQUENCE (SIZE (1.. maxNrofUL-Allocations)) OF INTEGER(0..32),
        p0alpha                                 P0-PUSCH-AlphaSetId
    },
    aperiodic                               SEQUENCE {
        reportSlotOffsetList                SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)
    }
},
```

201

***resourcesForChannelMeasurement***
Resources for channel measurement. csi-ResourceConfigId of a CSI-ResourceConfig included in the configuration of the serving cell indicated with the field "carrier" above. The CSI-ResourceConfig indicated here contains only NZP-CSI-RS resources and/or SSB resources. This CSI-ReportConfig is associated with the DL BWP indicated by bwp-Id in that CSI-ResourceConfig.

202

– *NZP-CSI-RS-ResourceSet*

The IE *NZP-CSI-RS-ResourceSet* is a set of Non-Zero-Power (NZP) CSI-RS resources (their IDs) and set-specific parameters.

***NZP-CSI-RS-ResourceSet* information element**

```
-- ASN1START
-- TAG-NZP-CSI-RS-RESOURCESET-START
NZP-CSI-RS-ResourceSet ::=          SEQUENCE {
    nzp-CSI-ResourceSetId               NZP-CSI-RS-ResourceSetId,
    nzp-CSI-RS-Resources                SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerSet)) OF NZP-CSI-RS-ResourceId,
    repetition                          ENUMERATED { on, off }                                  OPTIONAL,   -- Need S
    aperiodicTriggeringOffset           INTEGER(0..4)                                           OPTIONAL,   -- Need S
    trs-Info                            ENUMERATED {true}                                       OPTIONAL,   -- Need R
    ...
}

-- TAG-NZP-CSI-RS-RESOURCESET-STOP
-- ASN1STOP
```

203

```
reportQuantity                          CHOICE {
    none                                    NULL,
    cri-RI-PMI-CQI                          NULL,
    cri-RI-i1                               NULL,
    cri-RI-i1-CQI                           SEQUENCE {
        pdsch-BundleSizeForCSI                  ENUMERATED {n2, n4}     OPTIONAL    -- Need S
    },
    cri-RI-CQI                              NULL,
    cri-RSRP                                NULL,
    ssb-Index-RSRP                          NULL,
    cri-RI-LI-PMI-CQI                       NULL
```

204

245. For example, the Accused Products are each a UE wherein K1 antenna port groups of the K antenna port groups correspond to K1 channel quality values of the K channel quality values; the K1 is a positive integer less than or equal to the K. For example. Defendant and Accused Products practice wherein the CSI-RS (*i.e.*, first wireless signal), which is used for computing the CSI report, including the L1-RSRP, is transmitted by quasi-co-located (QCLed) antenna port

[201] *Id.*
[202] *Id.*
[203] *Id.*
[204] *Id.*

groups (*i.e.*, K antenna port groups). The CSI-ReportConfig specifies the CSI-RS resources, transmitted by one or more (*i.e.*, the K1 is a positive integer) quasi-co-located (QCLed) antenna port groups (*i.e.*, K1 antenna port groups of the K antenna port groups), via CSI-ResourceConfigID, for which channel quality values (*i.e.*, K1 channel quality values of the K channel quality values) including L1-RSRP are computed. The antenna port group includes a positive integer number of antenna port(s) (*e.g.*, number of ports) and antenna port group (*e.g.*, one or more ports included in one CSI-RS) is one of the K antenna port groups (the K1 is a positive integer less than or equal to the K).

### 5.2.1.1 Reporting settings

Each Reporting Setting *CSI-ReportConfig* is associated with a single downlink BWP (indicated by higher layer parameter *bwp-Id*) given in the associated *CSI-ResourceConfig* for channel measurement and contains the parameter(s) for one CSI reporting band:codebook configuration including codebook subset restriction, time-domain behavior, frequency granularity for CQI and PMI, measurement restriction configurations, and the CSI-related quantities to be reported by the UE such as the layer indicator (LI), L1-RSRP, CRI, and SSBRI (SSB Resource Indicator).

The time domain behavior of the *CSI-ReportConfig* is indicated by the higher layer parameter *reportConfigType* and can be set to 'aperiodic', 'semiPersistentOnPUCCH', 'semiPersistentOnPUSCH', or 'periodic'. For periodic and semiPersistentOnPUCCH/semiPersistentOnPUSCH CSI reporting, the configured periodicity and slot offset applies in the numerology of the UL BWP in which the CSI report is configured to be transmitted on. The higher layer parameter *reportQuantity* indicates the CSI-related or L1-RSRP-related quantities to report. The *reportFreqConfiguration* indicates the reporting granularity in the frequency domain, including the CSI reporting band and if PMI/CQI reporting is wideband or sub-band. The *timeRestrictionForChannelMeasurements* parameter in *CSI-ReportConfig* can be configured to enable time domain restriction for channel measurements and *timeRestrictionForInterferenceMeasurements* can be configured to enable time domain restriction for interference measurements. The *CSI-ReportConfig* can also contain *CodebookConfig*, which contains configuration parameters for Type-I or Type II CSI including codebook subset restriction, and configurations of group based reporting.[205]

– *CSI-ReportConfig*

The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent on PUSCH triggered by DCI received on the cell in which the CSI-ReportConfig is included (in this case, the cell on which the report is sent is determined by the received DCI). See 38.214, section 5.2.1.

**CSI-ReportConfig information element**

```
-- ASN1START
-- TAG-CSI-REPORTCONFIG-START

CSI-ReportConfig ::=                SEQUENCE {
```

ETSI [206]

[205] TS 38.214 V15.3.0
[206] TS 38.331 V15.3.0

```
reportConfigId                          CSI-ReportConfigId,
carrier                                 ServCellIndex                   OPTIONAL,   -- Need S
resourcesForChannelMeasurement          CSI-ResourceConfigId,
csi-IM-ResourcesForInterference         CSI-ResourceConfigId        OPTIONAL,   -- Need R
nzp-CSI-RS-ResourcesForInterference     CSI-ResourceConfigId        OPTIONAL,   -- Need R
reportConfigType                        CHOICE {
    periodic                                SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUCCH                   SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUSCH                   SEQUENCE {
        reportSlotConfig                        ENUMERATED {sl5, sl10, sl20, sl40, sl80, sl160, sl320},
        reportSlotOffsetList                SEQUENCE (SIZE (1.. maxNrofUL-Allocations)) OF INTEGER(0..32),
        p0alpha                                 P0-PUSCH-AlphaSetId
    },
    aperiodic                               SEQUENCE {
        reportSlotOffsetList                SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)
    }
},
```

[207]

***resourcesForChannelMeasurement***
Resources for channel measurement. csi-ResourceConfigId of a CSI-ResourceConfig included in the configuration of the serving cell indicated with the field "carrier" above. The CSI-ResourceConfig indicated here contains only NZP-CSI-RS resources and/or SSB resources. This CSI-ReportConfig is associated with the DL BWP indicated by bwp-Id in that CSI-ResourceConfig.

[208]

– *NZP-CSI-RS-ResourceSet*

The IE *NZP-CSI-RS-ResourceSet* is a set of Non-Zero-Power (NZP) CSI-RS resources (their IDs) and set-specific parameters.

***NZP-CSI-RS-ResourceSet* information element**

```
-- ASN1START
-- TAG-NZP-CSI-RS-RESOURCESET-START
NZP-CSI-RS-ResourceSet ::=          SEQUENCE {
    nzp-CSI-ResourceSetId               NZP-CSI-RS-ResourceSetId,
    nzp-CSI-RS-Resources                SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerSet)) OF NZP-CSI-RS-ResourceId,
    repetition                          ENUMERATED { on, off }                                  OPTIONAL,   -- Need S
    aperiodicTriggeringOffset           INTEGER(0..4)                                           OPTIONAL,   -- Need S
    trs-Info                            ENUMERATED {true}                                       OPTIONAL,   -- Need R
    ...
}

-- TAG-NZP-CSI-RS-RESOURCESET-STOP
-- ASN1STOP
```

[209]

246. For example, the Accused Products are each a UE wherein a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values; the first information is used to determine the K1 antenna port groups and the first proportional sequence; the first signaling is used to determine a target threshold; the target threshold is a non-negative real number; a first channel quality is a best channel quality value among the K1 channel quality values; a second channel quality is a worse channel quality value among the K1 channel quality values; a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold. The Accused Products practice wherein following the

[207] *Id.*
[208] *Id.*
[209] *Id.*

groupBasedBeamReporting configured as ‘enabled’, the UE shall use differential L1-RSRP based reporting corresponding to the CSI-RS resources associated with the CSI-ReportConfig (*i.e.*, a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values), where the largest measured value of L1-RSRP is quantized to a 7-bit value in the range [-140 (*i.e.*, a first channel quality is a best channel quality value among the K1 channel quality values), -44 (*i.e.*, a second channel quality is a worse channel quality value among the K1 channel quality values)] dBm with 1dB step size (the first signaling is used to determine a target threshold; the target threshold is a non-negative real number), and the differential L1-RSRP is quantized to a 4-bit value for specified CSI-RS resources. The differential L1-RSRP value is computed with 2 dB step size (*i.e.*, a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold) with a reference to the largest measured L1-RSRP value which is part of the same L1-RSRP reporting instance.

5.2.1.1 Reporting settings

Each Reporting Setting *CSI-ReportConfig* is associated with a single downlink BWP (indicated by higher layer parameter *bwp-Id*) given in the associated *CSI-ResourceConfig* for channel measurement and contains the parameter(s) for one CSI reporting band:codebook configuration including codebook subset restriction, time-domain behavior, frequency granularity for CQI and PMI, measurement restriction configurations, and the CSI-related quantities to be reported by the UE such as the layer indicator (LI), L1-RSRP, CRI, and SSBRI (SSB Resource Indicator).

The time domain behavior of the *CSI-ReportConfig* is indicated by the higher layer parameter *reportConfigType* and can be set to 'aperiodic', 'semiPersistentOnPUCCH', 'semiPersistentOnPUSCH', or 'periodic'. For periodic and semiPersistentOnPUCCH/semiPersistentOnPUSCH CSI reporting, the configured periodicity and slot offset applies in the numerology of the UL BWP in which the CSI report is configured to be transmitted on. The higher layer parameter *reportQuantity* indicates the CSI-related or L1-RSRP-related quantities to report. The *reportFreqConfiguration* indicates the reporting granularity in the frequency domain, including the CSI reporting band and if PMI/CQI reporting is wideband or sub-band. The *timeRestrictionForChannelMeasurements* parameter in *CSI-ReportConfig* can be configured to enable time domain restriction for channel measurements and *timeRestrictionForInterferenceMeasurements* can be configured to enable time domain restriction for interference measurements. The *CSI-ReportConfig* can also contain *CodebookConfig*, which contains configuration parameters for Type-I or Type II CSI including codebook subset restriction, and configurations of group based reporting. [210]

[210] TS 38.214 V15.3.0

– *CSI-ReportConfig*

The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent on PUSCH triggered by DCI received on the cell in which the CSI-ReportConfig is included (in this case, the cell on which the report is sent is determined by the received DCI). See 38.214, section 5.2.1.

***CSI-ReportConfig* information element**

```
-- ASN1START
-- TAG-CSI-REPORTCONFIG-START

CSI-ReportConfig ::=                SEQUENCE {
```

***ETSI***

[211]

```
reportConfigId                          CSI-ReportConfigId,
carrier                                 ServCellIndex                   OPTIONAL,   -- Need S
resourcesForChannelMeasurement          CSI-ResourceConfigId,
csi-IM-ResourcesForInterference         CSI-ResourceConfigId        OPTIONAL,   -- Need R
nzp-CSI-RS-ResourcesForInterference     CSI-ResourceConfigId        OPTIONAL,   -- Need R
reportConfigType                        CHOICE {
    periodic                                SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUCCH                   SEQUENCE {
        reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
        pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
    },
    semiPersistentOnPUSCH                   SEQUENCE {
        reportSlotConfig                        ENUMERATED {sl5, sl10, sl20, sl40, sl80, sl160, sl320},
        reportSlotOffsetList                SEQUENCE (SIZE (1.. maxNrofUL-Allocations)) OF INTEGER(0..32),
        p0alpha                                 P0-PUSCH-AlphaSetId
    },
    aperiodic                               SEQUENCE {
        reportSlotOffsetList                SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)
    }
},
```

[212]

```
reportQuantity                          CHOICE {
    none                                    NULL,
    cri-RI-PMI-CQI                          NULL,
    cri-RI-i1                               NULL,
    cri-RI-i1-CQI                           SEQUENCE {
        pdsch-BundleSizeForCSI                  ENUMERATED {n2, n4}     OPTIONAL    -- Need S
    },
    cri-RI-CQI                              NULL,
    cri-RSRP                                NULL,
    ssb-Index-RSRP                          NULL,
    cri-RI-LI-PMI-CQI                       NULL
```

[213]

```
timeRestrictionForChannelMeasurements           ENUMERATED {configured, notConfigured},
timeRestrictionForInterferenceMeasurements      ENUMERATED {configured, notConfigured},
codebookConfig                          CodebookConfig                                  OPTIONAL,   -- Need R
nrofCQIsPerReport                       ENUMERATED {n1, n2}                             OPTIONAL,   -- Need R
groupBasedBeamReporting                 CHOICE {
    enabled                                 NULL,
    disabled                                SEQUENCE {
        nrofReportedRS                      ENUMERATED {n1, n2, n3, n4}                 OPTIONAL    -- Need S
    }
```

[214]

[211] TS 38.331 V15.3.0
[212] *Id.*
[213] *Id.*
[214] *Id.*

#### 5.2.1.4.3 L1-RSRP Reporting

For L1-RSRP computation

- the UE may be configured with CSI-RS resources, SS/PBCH Block resources or both CSI-RS and SS/PBCH block resources, when resource-wise quasi co-located with 'QCL-Type C' and 'QCL-TypeD' when applicable.
- the UE may be configured with CSI-RS resource setting up to 16 CSI-RS resource sets having up to 64 resources within each set. The total number of different CSI-RS resources over all resource sets is no more than 128.

For L1-RSRP reporting, if the higher layer parameter *nrofReportedRS* in *CSI-ReportConfig* is configured to be one, the reported L1-RSRP value is defined by a 7-bit value in the range [-140, -44] dBm with 1dB step size, if the higher layer parameter *nrofReportedRS* is configured to be larger than one, or if the higher layer parameter *groupBasedBeamReporting* is configured as 'enabled', the UE shall use differential L1-RSRP based reporting, where the largest measured value of L1-RSRP is quantized to a 7-bit value in the range [-140, -44] dBm with 1dB step size, and the differential L1-RSRP is quantized to a 4-bit value. The differential L1-RSRP value is computed with 2 dB step size with a reference to the largest measured L1-RSRP value which is part of the same L1-RSRP reporting instance. The mapping between the reported L1-RSRP value and the measured quantity is described in [11, TS 38.133]. [215]

### 10.1.6 RSRP Measurement Report Mapping

The reporting range of SS-RSRP for L3 reporting is defined from -156 dBm to -31 dBm with 1 dB resolution. The reporting range of SS-RSRP and CSI-RSRP for L1 reporting is defined from -140 to -40dBm with 1dB resolution.

The mapping of measured quantity is defined in Table 10.1.6.1-1. The range in the signalling may be larger than the guaranteed accuracy range.

The reporting range of differential SS-RSRP and CSI-RSRP for L1 reporting is defined from 0 dBm to -30 dB with 2 dB resolution.

The mapping of measured quantity is defined in Table 10.1.6.1-2. The range in the signalling may be larger than the guaranteed accuracy range. [216]

[215] TS 38.214 V15.3.0
[216] TS 38.133 V15.3.0

**Table 10.1.6.1-1: SS-RSRP and CSI-RSRP measurement report mapping**

| Reported value | Measured quantity value(L3 SS-RSRP) | Measured quantity value(L1 SS-RSRP and CSI-RSRP) | Unit |
|---|---|---|---|
| RSRP_0 | SS-RSRP<-156 | Not valid | dBm |
| RSRP_1 | -156≤ SS-RSRP<-155 | Not valid | dBm |
| RSRP_2 | -155≤ SS-RSRP<-154 | Not valid | dBm |
| RSRP_3 | -154≤ SS-RSRP<-153 | Not valid | dBm |
| RSRP_4 | -153≤ SS-RSRP<-152 | Not valid | dBm |
| RSRP_5 | -152≤ SS-RSRP<-151 | Not valid | dBm |
| RSRP_6 | -151≤ SS-RSRP<-150 | Not valid | dBm |
| RSRP_7 | -150≤ SS-RSRP<-149 | Not valid | dBm |
| RSRP_8 | -149≤ SS-RSRP<-148 | Not valid | dBm |
| RSRP_9 | -148≤ SS-RSRP<-147 | Not valid | dBm |
| RSRP_10 | -147≤ SS-RSRP<-146 | Not valid | dBm |
| RSRP_11 | -146≤ SS-RSRP<-145 | Not valid | dBm |
| RSRP_12 | -145≤ SS-RSRP<-144 | Not valid | dBm |
| RSRP_13 | -144≤ SS-RSRP<-143 | Not valid | dBm |
| RSRP_14 | -143≤ SS-RSRP<-142 | Not valid | dBm |
| RSRP_15 | -142≤ SS-RSRP<-141 | Not valid | dBm |
| RSRP_16 | -141≤ SS-RSRP<-140 | Not valid | dBm |
| RSRP_17 | -140≤ SS-RSRP<-139 | RSRP<-139 | dBm |
| RSRP_18 | -139≤ SS-RSRP<-138 | -139≤ RSRP<-138 | dBm |
| --- | --- | | --- |
| RSRP_111 | -46≤ SS-RSRP<-45 | -46≤ RSRP<-45 | dBm |
| RSRP_112 | -45≤ SS-RSRP<-44 | -45≤ RSRP | dBm |
| RSRP_113 | -44≤ SS-RSRP<-43 | Not valid | dBm |
| RSRP_114 | -43≤ SS-RSRP<-42 | Not valid | dBm |
| RSRP_115 | -42≤ SS-RSRP<-41 | Not valid | dBm |
| RSRP_116 | -41≤ SS-RSRP<-40 | Not valid | dBm |
| RSRP_117 | -40≤ SS-RSRP<-39 | Not valid | dBm |
| RSRP_118 | -39≤ SS-RSRP<-38 | Not valid | dBm |
| RSRP_119 | -38≤ SS-RSRP<-37 | Not valid | dBm |
| RSRP_120 | -37≤ SS-RSRP<-36 | Not valid | dBm |
| RSRP_121 | -36≤ SS-RSRP<-35 | Not valid | dBm |
| RSRP_122 | -35≤ SS-RSRP<-34 | Not valid | dBm |
| RSRP_123 | -34≤ SS-RSRP<-33 | Not valid | dBm |
| RSRP_124 | -33≤ SS-RSRP<-32 | Not valid | dBm |
| RSRP_125 | -32≤ SS-RSRP<-31 | Not valid | dBm |
| RSRP_126 | -31≤ SS-RSRP | Not valid | dBm |
| RSRP_127 | Infinity | Not valid | dBm |

[217]

[217] *Id.*

**Table 10.1.6.1-2:Differential SS-RSRP and CSI-RSRP measurement report mapping**

| Reported value | Measured quantity value(difference in measured RSRP from strongest RSRP) | Unit |
|---|---|---|
| DIFFRSRP_0 | 0≥ΔRSRP>-2 | dB |
| DIFFRSRP_1 | -2≥ΔRSRP>-4 | dB |
| DIFFRSRP_2 | -4≥ΔRSRP>-6 | dB |
| DIFFRSRP_3 | -6≥ΔRSRP>-8 | dB |
| DIFFRSRP_4 | -8≥ΔRSRP>-10 | dB |
| DIFFRSRP_5 | -10≥ΔRSRP>-12 | dB |
| DIFFRSRP_6 | -12≥ΔRSRP>-14 | dB |
| DIFFRSRP_7 | -14≥ΔRSRP>-16 | dB |
| DIFFRSRP_8 | -16≥ΔRSRP>-18 | dB |
| DIFFRSRP_9 | -18≥ΔRSRP>-20 | dB |
| DIFFRSRP_10 | -20≥ΔRSRP>-22 | dB |
| DIFFRSRP_11 | -22≥ΔRSRP>-24 | dB |
| DIFFRSRP_12 | -24≥ΔRSRP>-26 | dB |
| DIFFRSRP_13 | -26≥ΔRSRP>-28 | dB |
| DIFFRSRP_14 | -28≥ΔRSRP>-30 | dB |
| DIFFRSRP_15 | -30≥ΔRSRP | dB |

[218]

247. For example, the Accused Products are each a UE wherein the first signaling is a RRC (Radio Resource Control) signaling; the first information is transmitted in a CSI (Channel State Information) report; the first information is carried by a PUSCH (Physical Uplink Shared Channel) or a PUCCH (Physical Uplink Control Channel). For example. Defendant and Accused Products practice wherein the first signaling (*e.g.*, CSI-ReportConfig IE, CSI-ResourceConfig IE, CSI-AperiodicTriggerStateList, CSI-SemiPersistentOnPUSCH-TriggerStateList) is from the higher layer (*i.e.*, through RRC Configuration). The L1-RSRP information (*i.e.*, the first information) is transmitted in channel state information, wherein the channel state information report is transmitted either via the physical uplink control channel (PUCCH) for periodic/semi-persistent CSI reporting, or through the physical uplink shared channel (PUSCH) for aperiodic

[218] *Id.*

CSI reporting.

# 1 Scope

The present document specifies the Radio Resource Control protocol for the radio interface between UE and NG-RAN.

The scope of the present document also includes:

- the radio related information transported in a transparent container between source gNB and target gNB upon inter gNB handover;
- the radio related information transported in a transparent container between a source or target gNB and another system upon inter RAT handover.
- the radio related information transported in a transparent container between a source eNB and target gNB during E-UTRA-NR Dual Connectivity.

[219].


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[220]

## 5.2.1 Channel state information framework

The time and frequency resources that can be used by the UE to report CSI are controlled by the gNB. CSI may consist of Channel Quality Indicator (CQI), precoding matrix indicator (PMI), CSI-RS resource indicator (CRI), SS/PBCH Block Resource indicator (SSBRI), layer indicator (LI), rank indicator (RI) and/or L1-RSRP.

For CQI, PMI, CRI, SSBRI, LI, RI, L1-RSRP, a UE is configured by higher layers with N≥1 *CSI-ReportConfig* Reporting Settings, M≥1 *CSI-ResourceConfig* Resource Settings, and one or two list(s) of trigger states (given by the higher layer parameters *CSI-AperiodicTriggerStateList* and *CSI-SemiPersistentOnPUSCH-TriggerStateList*). Each trigger state in *CSI-AperiodicTriggerStateList* contains a list of associated *CSI-ReportConfigs* indicating the Resource Set IDs for channel and optionally for interference. Each trigger state in *CSI-SemiPersistentOnPUSCH-TriggerStateList* contains one associated *CSI-ReportConfig*. [221]

[219] TS 38.331 V15.3.0
[220] *Id.*
[221] TS 38.214 V15.3.0

#### 5.2.1.1 Reporting settings

Each Reporting Setting *CSI-ReportConfig* is associated with a single downlink BWP (indicated by higher layer parameter *bwp-Id*) given in the associated *CSI-ResourceConfig* for channel measurement and contains the parameter(s) for one CSI reporting band:codebook configuration including codebook subset restriction, time-domain behavior, frequency granularity for CQI and PMI, measurement restriction configurations, and the CSI-related quantities to be reported by the UE such as the layer indicator (LI), L1-RSRP, CRI, and SSBRI (SSB Resource Indicator). [222]

### 5.2.4 CSI reporting using PUCCH

A UE is semi-statically configured by higher layers to perform periodic CSI Reporting on the PUCCH. A UE can be configured by higher layers for multiple periodic CSI Reports corresponding to multiple higher layer configured CSI Reporting Settings, where the associated CSI Resource Settings are higher layer configured. Periodic CSI reporting on PUCCH formats 2, 3, 4 supports Type I CSI with wideband granularity.

A UE shall perform semi-persistent CSI reporting on the PUCCH applied starting from slot $n + 3N_{slot}^{subframe,\mu} + 1$ after the HARQ-ACK corresponding to the PDSCH carrying the selection command [10, TS 38.321] is transmitted in slot *n*. The selection command will contain one or more Reporting Settings where the associated CSI Resource Settings are configured. Semi-persistent CSI reporting on the PUCCH supports Type I CSI. Semi-persistent CSI reporting on the PUCCH format 2 supports Type I CSI with wideband frequency granularity. Semi-persistent CSI reporting on PUCCH formats 3 or 4 supports Type I CSI with wideband and sub-band frequency granularities and Type II CSI Part 1. [223]

### 5.2.3 CSI reporting using PUSCH

A UE shall perform aperiodic CSI reporting using PUSCH on serving cell c upon successful decoding of a DCI format 0_1 which triggers an aperiodic CSI trigger state. [224]

#### 5.2.1.4.2 Report Quantity Configurations

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RSRP', 'cri-RI-PMI-CQI ', 'cri-RI-i1', 'cri-RI-i1-CQI', 'cri-RI-CQI' or 'cri-RI-LI-PMI-CQI', and $K_s > 1$ resources are configured in the corresponding resource set for channel measurement, then the UE shall derive the CSI parameters other than CRI conditioned on the reported CRI, where CRI $k$ ($k \geq 0$) corresponds to the configured ($k$+1)-th entry of associated *nzp-CSI-RSResource* in the corresponding *nzp-CSI-RS-ResourceSet* for channel measurement, and ($k$+1)-th entry of associated *csi-IM-Resource* in the corresponding *csi-IM-ResourceSet* (if configured) If $K_s = 2$ CSI-RS resources are configured, each resource shall contain at most 16 CSI-RS ports. If $2 < K_s \leq 8$ CSI-RS resources are configured, each resource shall contain at most 8 CSI-RS ports. [225]

```
reportQuantity                          CHOICE {
    none                                    NULL,
    cri-RI-PMI-CQI                          NULL,
    cri-RI-i1                               NULL,
    cri-RI-i1-CQI                           SEQUENCE {
        pdsch-BundleSizeForCSI                  ENUMERATED {n2, n4}     OPTIONAL    -- Need S
    },
    cri-RI-CQI                              NULL,
    cri-RSRP                                NULL,
    ssb-Index-RSRP                          NULL,
    cri-RI-LI-PMI-CQI                       NULL
```
[226]

[222] *Id.*
[223] *Id.*
[224] *Id.*
[225] *Id.*
[226] TS 38.331 V15.3.0

248. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’904 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant’s customers and end-users, in this District and elsewhere in the United States. For example, Defendant’s customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the ’904 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[227] Because of Defendant’s inducement, Defendant’s customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the ’904 Patent. Defendant performs these affirmative acts with knowledge of the ’904 Patent and with the intent, or willful blindness, that the induced acts directly infringe the ’904 Patent.

249. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’904 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant’s affirmative acts of selling and offering to sell the Accused Products in this District

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[227] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

and elsewhere in the United States and causing the Accused Products to be manufactured, used, sold, and offered for sale contribute to others' use and manufacture of the Accused Products such that the '904 Patent is directly infringed by others. The accused components within the Accused Products including, but not limited to, chipsets manufactured by Defendant, are material to the invention of the '904 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the '904 Patent. Defendant performs these affirmative acts with knowledge of the '904 Patent and with intent, or willful blindness, that they cause the direct infringement of the '904 Patent.

250. ABT has suffered damages as a result of Defendant's direct and indirect infringement of the '904 Patent in an amount to be proved at trial.

251. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant's infringement of the '904 Patent, for which there is no adequate remedy at law, unless Defendant's infringement is enjoined by this Court.

252. On information and belief, Defendant acted egregiously and with willful misconduct in that their actions constituted direct or indirect infringement of a valid patent, and this was either known or so obvious that Defendant should have known about it. Defendant continue to infringe the '904 Patent by making, using, selling, offering for sale and/or importing in the United States the Accused Products and by inducing the direct infringing use, sale, offer for sale, and importation of the Accused Products by others, in reckless disregard of ABT's patent rights. Defendant has committed and continues to commit acts of infringement that Defendant actually knew or should have known constituted an unjustifiably high risk of infringement of at least one valid and enforceable claim of the '904 Patent. Upon information and belief, Defendant

had actual knowledge of the ’904 Patent from related prior litigations accusing either the same products involving Defendant and products with similar 5G functionalities involving direct competitors of Defendant. Defendant’’ infringement of the ’904 Patent has been and continues to be willful, entitling ABT to an award of treble damages, reasonable attorney fees, and costs in bringing this action under 35 U.S.C. §§ 284 and 285.

**COUNT XIII**
**(Infringement of the ’581 Patent)**

253. The preceding paragraphs are incorporated by reference as if fully set forth herein.

254. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the ’581 Patent.

255. Defendant has and continues to directly infringe the ’581 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the ’581 Patent. Such products include at least Accused Products including, but not limited to, Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which practice a UE for paging, comprising: a first receiver, to monitor a first signaling in X time intervals; and a second receiver, to receive a first radio signal; wherein X is a positive integer; the first signaling is used for determining scheduling information for the first radio signal; the scheduling information comprises occupied time-frequency resource, adopted MCS, and

subcarrier spacing of subcarriers in occupied frequency domain resource; the first radio signal carries a paging message; the frequency domain resource used for transmitting the first signaling belongs to a first subband; the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and location of the first subband in frequency domain is used for determining the X time intervals.

256. For example, Defendant has and continues to directly infringe at least claim 13 of the ’581 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards such as the Accused Products (e.g., 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware for implementing 3rd Generation Partnership Product (3GPP) specifications).

257. The Accused Products comprise a first receiver, to monitor a first signaling in X time intervals and a second receiver, to receive a first radio signal; wherein X is a positive integer. For example, the Accused Products monitor a first signaling (*e.g.*, paging DCI, P-RNTI) in X time intervals (*e.g.*, paging occasion or PDCCH monitoring occasions) and receive a first radio signal (*e.g.*, paging messages on the paging control channel/PDSCH) wherein X is a positive integer (*e.g.*, multiple time slots).

> **7.1 Discontinuous Reception for paging**
>
> The UE may use Discontinuous Reception (DRX) in RRC_IDLE and RRC_INACTIVE state in order to reduce power consumption. The UE monitors one paging occasion (PO) per DRX cycle. A PO is a set of PDCCH monitoring occasions and can consist of multiple time slots (e.g. subframe or OFDM symbol) where paging DCI can be sent (TS 38.213 [4]). One Paging Frame (PF) is one Radio Frame and may contain one or multiple PO(s) or starting point of a PO.

[228]

[228] TS38.304 V15.3.0, Section 7.1

## 4.2 Downlink

Table 4.2-1 specifies the mapping of the downlink transport channels to their corresponding physical channels. Table 4.2-2 specifies the mapping of the downlink control channel information to its corresponding physical channel.

**Table 4.2-1**

| TrCH | Physical Channel |
|---|---|
| DL-SCH | PDSCH |
| BCH | PBCH |
| PCH | PDSCH |

[229]

## 6.2.2 Logical Channels

Different kinds of data transfer services as offered by MAC. Each logical channel type is defined by what type of information is transferred. Logical channels are classified into two groups: Control Channels and Traffic Channels. Control channels are used for the transfer of control plane information only:

- Broadcast Control Channel (BCCH): a downlink channel for broadcasting system control information.
- Paging Control Channel (PCCH): a downlink channel that carries paging messages.

[230]

## 6.2.3 Mapping to Transport Channels

In Downlink, the following connections between logical channels and transport channels exist:

- BCCH can be mapped to BCH;
- BCCH can be mapped to DL-SCH;
- PCCH can be mapped to PCH;

[231]

## 9.2.5 Paging

Paging allows the network to reach UEs in RRC_IDLE and in RRC_INACTIVE state through *Paging* messages, and to notify UEs in RRC_IDLE, RRC_INACTIVE and RRC_CONNECTED state of system information change (see subclause 7.3.3) and ETWS/CMAS indications (see subclause 16.4) through *Short Messages*. Both *Paging* messages and *Short Messages* are addressed with P-RNTI on PDCCH, but while the former is sent on PCCH, the latter is sent over PDCCH directly (see subclause 6.5 of TS 38.331 [12]).

[232]

258. The Accused Products are each a UE wherein the first signaling is used for determining scheduling information for the first radio signal; the scheduling information comprises occupied time-frequency resource, adopted MCS, and subcarrier spacing of subcarriers in

[229] TS38.212 V15.3.0, Section 4.2
[230] TS38.300 V15.5.0, Section 6.2.2
[231] TS38.300 V15.5.0, Section 6.2.3
[232] TS38.300 V15.5.0, Section 9.2.5

occupied frequency domain resource. For example, the Accused Products practice the first signaling (*e.g.*, paging DCI, P-RNTI) is used for determining scheduling information for the first radio signal; the scheduling information comprises occupied time-frequency resource (*e.g.*, frequency domain resource assignment; time domain resource assignment) and adopted Modulation Coding Scheme (MCS) (*e.g.*, modulation and coding scheme).

> 7.3.1.2.1 Format 1_0
>
> DCI format 1_0 is used for the scheduling of PDSCH in one DL cell.

> The following information is transmitted by means of the DCI format 1_0 with CRC scrambled by P-RNTI:
>
> - Short Messages Indicator – 2 bits according to Table 7.3.1.2.1-1.
> - Short Messages – 8 bits, according to Subclause x.x of [9, TS38.331]. If only the scheduling information for Paging is carried, this bit field is reserved.
> - Frequency domain resource assignment – $\lceil \log_2(N_{RB}^{DL,BWP}(N_{RB}^{DL,BWP}+1)/2) \rceil$ bits. If only the short message is carried, this bit field is reserved.
>  - $N_{RB}^{DL,BWP}$ is the size of CORESET 0
> - Time domain resource assignment – 4 bits as defined in Subclause 5.1.2.1 of [6, TS38.214]. If only the short message is carried, this bit field is reserved.
> - VRB-to-PRB mapping – 1 bit according to Table 7.3.1.1.2-33. If only the short message is carried, this bit field is reserved.
> - Modulation and coding scheme – 5 bits as defined in Subclause 5.1.3 of [6, TS38.214], using Table 5.1.3.1-1. If only the short message is carried, this bit field is reserved.

[233]

259. For further example, subcarrier spacing information (*e.g.*, subcarrierSpacingCommon) is already included in the MIB information element and bandwidth part (BWP) information element (as subcarrierSpacing) and is used for determining the scheduling information. The BWP information element comprises: 1) locationAndBandwidth; and 2) subcarrier spacing.

> 6.2.2 Message definitions

[233] TS38.212 V15.3.0, Section 7.3.1

– *MIB*

The *MIB* includes the system information transmitted on BCH.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: BCCH

Direction: Network to UE

***MIB***

```
-- ASN1START
-- TAG-MIB-START

MIB ::=                             SEQUENCE {
    systemFrameNumber                   BIT STRING (SIZE (6)),
    subCarrierSpacingCommon             ENUMERATED {scs15or60, scs30or120},
    ssb-SubcarrierOffset                INTEGER (0..15),
    dmrs-TypeA-Position                 ENUMERATED {pos2, pos3},
    pdcch-ConfigSIB1                    PDCCH-ConfigSIB1,
    cellBarred                          ENUMERATED {barred, notBarred},
    intraFreqReselection                ENUMERATED {allowed, notAllowed},
    spare                               BIT STRING (SIZE (1))
}

-- TAG-MIB-STOP
-- ASN1STOP
```

| ***MIB field descriptions*** |
|---|
| ***cellBarred***<br>barred means the cell is barred, as defined in TS 38.304 [20]. |
| ***dmrs-TypeA-Position***<br>Position of (first) DM-RS for downlink (see 38.211, section 7.4.1.1.1) and uplink (see 38.211, section 6.4.1.1.3). |
| ***intraFreqReselection***<br>Controls cell selection/reselection to intra-frequency cells when the highest ranked cell is barred, or treated as barred by the UE, as specified in TS 38.304 [20]. |
| ***pdcch-ConfigSIB1***<br>See TS 38.213 [13]. Determines a common *ControlResourceSet* (CORESET) a common search space and necessary PDCCH parameters. If the field *ssb-SubcarrierOffset* indicates that *SIB1* is not present, the field *pdcch-ConfigSIB1* indicate the frequency positions where the UE may find SS/PBCH block with *SIB1* or the frequency range where the network does not provide SS/PBCH block with *SIB1* (see TS 38.213 [13], section 13). |
| ***ssb-SubcarrierOffset***<br>Corresponds to $k_{SSB}$ (see TS 38.213 [13]), which is the frequency domain offset between SSB and the overall resource block grid in number of subcarriers. (See 38.211).<br>The value range of this field may be extended by an additional most significant bit encoded within PBCH as specified in 38.213 [13].<br>This field may indicate that this beam does not provide *SIB1* and that there is hence no common CORESET (see TS 38.213 [13], section 13). In this case, the field *pdcch-ConfigSIB1* may indicate the frequency positions where the UE may (not) find a SS/PBCH with a control resource set and search space for SIB1 (see 38.213 [13], section 13). |
| ***subCarrierSpacingCommon***<br>Subcarrier spacing for SIB1, Msg.2/4 for initial access and broadcast SI-messages. If the UE acquires this MIB on a carrier frequency <6GHz, the value *scs15or60* corresponds to 15 Khz and the value *scs30or120* corresponds to 30 kHz. If the UE acquires this MIB on a carrier frequency >6GHz, the value *scs15or60* corresponds to 60 Khz and the value *scs30or120* corresponds to 120 kHz. |
| ***systemFrameNumber***<br>The 6 most significant bit (MSB) of the 10-bit System Frame Number. The 4 LSB of the SFN are conveyed in the PBCH transport block as part of channel coding (i.e. outside the MIB encoding). |

234

### 6.3.2 Radio resource control information elements

– *BWP*

The *BWP* IE is used to configure a bandwidth part as defined in 38.211, section 4.2.2.

[234] TS38.331 V15.3.0, Section 6.2.2

For each serving cell the network configures at least an initial bandwidth part comprising of at least a downlink bandwidth part and one (if the serving cell is configured with an uplink) or two (if using supplementary uplink (SUL)) uplink bandwidth parts. Furthermore, the network may configure additional uplink and downlink bandwidth parts for a serving cell.

The bandwidth part configuration is split into uplink and downlink parameters and into common and dedicated parameters. Common parameters (in BWP-UplinkCommon and BWP-DownlinkCommon) are "cell specific" and the network ensures the necessary alignment with corresponding parameters of other UEs. The common parameters of the initial bandwidth part of the PCell are also provided via system information. For all other serving cells, the network provides the common parameters via dedicated signalling.

***BWP* information element**

```
-- ASN1START
-- TAG-BANDWIDTH-PART-START

BWP ::=                         SEQUENCE {
    locationAndBandwidth            INTEGER (0..37949),
    subcarrierSpacing               SubcarrierSpacing,
    cyclicPrefix                    ENUMERATED { extended }                    OPTIONAL    -- Need R
}


-- TAG-BANDWIDTH-PART-STOP
-- ASN1STOP
```

| ***BWP field descriptions*** |
|---|
| ***cyclicPrefix***<br>Indicates whether to use the extended cyclic prefix for this bandwidth part. If not set, the UE uses the normal cyclic prefix. Normal CP is supported for all numerologies and slot formats. Extended CP is supported only for 60 kHz subcarrier spacing. (see 38.211, section 4.2.2) |
| ***locationAndBandwidth***<br>Frequency domain location and bandwidth of this bandwidth part. The value of the field shall be interpreted as resource indicator value (RIV) as defined TS 38.214 with assumptions as described in TS 38.213, section 12, i.e. setting $N_{BWP}^{size}$=275. The first PRB is a PRB determined by subcarrierSpacing of this BWP and offsetToCarrier (configured in SCS-SpecificCarrier contained within FrequencyInfoDL / FrequencyInfoUL) corresponding to this subcarrier spacing. In case of TDD, a BWP-pair (UL BWP and DL BWP with the same bwp-Id) must have the same center frequency (see 38.213, section 12) |
| ***subcarrierSpacing***<br>Subcarrier spacing to be used in this BWP for all channels and reference signals unless explicitly configured elsewhere. Corresponds to subcarrier spacing according to 38.211, Table 4.2-1. The value kHz15 corresponds to μ=0, kHz30 to μ=1, and so on. Only the values 15, 30, or 60 kHz (<6GHz), and 60 or 120 kHz (>6GHz) are applicable. For the initial DL BWP this field has the same value as the field subCarrierSpacingCommon in MIB of the same serving cell. |

[235]

260. The Accused Products are each a UE wherein the first radio signal carries a paging message; the frequency domain resource used for transmitting the first signaling belongs to a first subband; the first subband comprises a positive integer number of consecutive subcarriers in frequency domain. For example, the Accused Products utilize a first radio signal (*e.g.*, paging messages on the paging control channel/PDSCH) that carries a paging message.

## 6.2.2 Logical Channels

Different kinds of data transfer services as offered by MAC. Each logical channel type is defined by what type of information is transferred. Logical channels are classified into two groups: Control Channels and Traffic Channels. Control channels are used for the transfer of control plane information only:

- Broadcast Control Channel (BCCH): a downlink channel for broadcasting system control information.
- Paging Control Channel (PCCH): a downlink channel that carries paging messages.

[236]

[235] TS38.331 V15.3.0, Section 6.3.2
[236] TS38.300 V15.5.0

### 9.2.5 Paging

Paging allows the network to reach UEs in RRC_IDLE and in RRC_INACTIVE state through *Paging* messages, and to notify UEs in RRC_IDLE, RRC_INACTIVE and RRC_CONNECTED state of system information change (see subclause 7.3.3) and ETWS/CMAS indications (see subclause 16.4) through *Short Messages*. Both *Paging* messages and *Short Messages* are addressed with P-RNTI on PDCCH, but while the former is sent on PCCH, the latter is sent over PDCCH directly (see subclause 6.5 of TS 38.331 [12]). [237]

261. For example, the frequency domain resource used for transmitting the first signaling (*e.g.*, PDSCH, PDCCH) belongs to a first subband (*e.g.*, bandwidth part). The bandwidth part (BWP) comprises of a set of Physical Resource Blocks (PRBs) which are measured from a reference resource block termed as Common Resource Block. As each of the Physical Resource Blocks comprises 12 subcarriers, the BWP comprises of a positive integer number of consecutive subcarriers in frequency domain.

### 4.4.5 Bandwidth part

A bandwidth part is a subset of contiguous common resource blocks defined in subclause 4.4.4.3 for a given numerology $\mu_i$ in bandwidth part $i$ on a given carrier. The starting position $N_{\mathrm{BWP},i}^{\mathrm{start},\mu}$ and the number of resource blocks $N_{\mathrm{BWP},i}^{\mathrm{size},\mu}$ in a bandwidth part shall fulfil $N_{\mathrm{grid},x}^{\mathrm{start},\mu} \le N_{\mathrm{BWP},i}^{\mathrm{start},\mu} < N_{\mathrm{grid},x}^{\mathrm{start},\mu} + N_{\mathrm{grid},x}^{\mathrm{size},\mu}$ and $N_{\mathrm{grid},x}^{\mathrm{start},\mu} < N_{\mathrm{BWP},i}^{\mathrm{size},\mu} + N_{\mathrm{BWP},i}^{\mathrm{start},\mu} \le N_{\mathrm{grid},x}^{\mathrm{start},\mu} + N_{\mathrm{grid},x}^{\mathrm{size},\mu}$, respectively. Configuration of a bandwidth part is described in clause 12 of [5, TS 38.213].

A UE can be configured with up to four bandwidth parts in the downlink with a single downlink bandwidth part being active at a given time. The UE is not expected to receive PDSCH, PDCCH, or CSI-RS (except for RRM) outside an active bandwidth part.

### 4.4.4 Resource blocks

#### 4.4.4.1 General

A resource block is defined as $N_{\mathrm{sc}}^{\mathrm{RB}} = 12$ consecutive subcarriers in the frequency domain.

[237] TS38.300 V15.5.0

## 4.2 Numerologies

Multiple OFDM numerologies are supported as given by Table 4.2-1 where $\mu$ and the cyclic prefix for a bandwidth part are obtained from the higher-layer parameter *subcarrierSpacing* and *cyclicPrefix*, respectively.

**Table 4.2-1: Supported transmission numerologies.**

| $\mu$ | $\Delta f = 2^{\mu} \cdot 15$ [kHz] | **Cyclic prefix** |
|---|---|---|
| 0 | 15 | Normal |
| 1 | 30 | Normal |
| 2 | 60 | Normal, Extended |
| 3 | 120 | Normal |
| 4 | 240 | Normal |

## 4.4.3 Resource elements

Each element in the resource grid for antenna port $p$ and subcarrier spacing configuration $\mu$ is called a resource element and is uniquely identified by $(k,l)_{p,\mu}$ where $k$ is the index in the frequency domain and $l$ refers to the symbol position in the time domain relative to some reference point. Resource element $(k,l)_{p,\mu}$ corresponds to a physical resource and the complex value $a_{k,l}^{(p,\mu)}$. When there is no risk for confusion, or no particular antenna port or subcarrier spacing is specified, the indices $p$ and $\mu$ may be dropped, resulting in $a_{k,l}^{(p)}$ or $a_{k,l}$.

### 4.4.4.3 Common resource blocks

Common resource blocks are numbered from 0 and upwards in the frequency domain for subcarrier spacing configuration $\mu$. The center of subcarrier 0 of common resource block 0 for subcarrier spacing configuration $\mu$ coincides with 'point A'.

The relation between the common resource block number $n_{\mathrm{CRB}}^{\mu}$ in the frequency domain and resource elements $(k,$ for subcarrier spacing configuration $\mu$ is given by

$$n_{\mathrm{CRB}}^{\mu} = \left\lfloor \frac{k}{N_{\mathrm{sc}}^{\mathrm{RB}}} \right\rfloor$$

where $k$ is defined relative to point A such that $k = 0$ corresponds to the subcarrier centered around point A.

### 4.4.4.4 Physical resource blocks

Physical resource blocks are defined within a bandwidth part and numbered from 0 to $N_{\mathrm{BWP},i}^{\mathrm{size}} - 1$ where $i$ is the number of the bandwidth part. The relation between the physical resource block $n_{\mathrm{PRB}}$ in bandwidth part $i$ and the common resource block $n_{\mathrm{CRB}}$ is given by

$$n_{\mathrm{CRB}} = n_{\mathrm{PRB}} + N_{\mathrm{BWP},i}^{\mathrm{start}}$$

238

[238] TS38.211 V15.2.0, Section 4.4

# 12 Bandwidth part operation

If the UE is configured with a SCG, the UE shall apply the procedures described in this clause for both MCG and SCG

- When the procedures are applied for MCG, the terms 'secondary cell', 'secondary cells' , 'serving cell', 'serving cells' in this clause refer to secondary cell, secondary cells, serving cell, serving cells belonging to the MCG respectively.
- When the procedures are applied for SCG, the terms 'secondary cell', 'secondary cells', 'serving cell', 'serving cells' in this clause refer to secondary cell, secondary cells (not including PSCell), serving cell, serving cells belonging to the SCG respectively. The term 'primary cell' in this clause refers to the PSCell of the SCG.

A UE configured for operation in bandwidth parts (BWPs) of a serving cell, is configured by higher layers for the serving cell a set of at most four bandwidth parts (BWPs) for receptions by the UE (DL BWP set) in a DL bandwidth by parameter *BWP-Downlink* and a set of at most four BWPs for transmissions by the UE (UL BWP set) in an UL bandwidth by parameter *BWP-Uplink*. [239]

– *BWP*

The *BWP* IE is used to configure a bandwidth part as defined in 38.211, section 4.2.2.

For each serving cell the network configures at least an initial bandwidth part comprising of at least a downlink bandwidth part and one (if the serving cell is configured with an uplink) or two (if using supplementary uplink (SUL)) uplink bandwidth parts. Furthermore, the network may configure additional uplink and downlink bandwidth parts for a serving cell.

The bandwidth part configuration is split into uplink and downlink parameters and into common and dedicated parameters. Common parameters (in BWP-UplinkCommon and BWP-DownlinkCommon) are "cell specific" and the network ensures the necessary alignment with corresponding parameters of other UEs. The common parameters of the initial bandwidth part of the PCell are also provided via system information. For all other serving cells, the network provides the common parameters via dedicated signalling.

***BWP* information element**

```
-- ASN1START
-- TAG-BANDWIDTH-PART-START

BWP ::=                         SEQUENCE {
    locationAndBandwidth            INTEGER (0..37949),
    subcarrierSpacing               SubcarrierSpacing,
    cyclicPrefix                    ENUMERATED { extended }                    OPTIONAL    -- Need R
}


-- TAG-BANDWIDTH-PART-STOP
-- ASN1STOP
```

| ***BWP* field descriptions** |
|---|
| ***cyclicPrefix***<br>Indicates whether to use the extended cyclic prefix for this bandwidth part. If not set, the UE uses the normal cyclic prefix. Normal CP is supported for all numerologies and slot formats. Extended CP is supported only for 60 kHz subcarrier spacing. (see 38.211, section 4.2.2) |
| ***locationAndBandwidth***<br>Frequency domain location and bandwidth of this bandwidth part. The value of the field shall be interpreted as resource indicator value (RIV) as defined TS 38.214 with assumptions as described in TS 38.213, section 12, i.e. setting $N_{BWP}^{size}$=275. The first PRB is a PRB determined by subcarrierSpacing of this BWP and offsetToCarrier (configured in SCS-SpecificCarrier contained within FrequencyInfoDL / FrequencyInfoUL) corresponding to this subcarrier spacing. In case of TDD, a BWP-pair (UL BWP and DL BWP with the same bwp-Id) must have the same center frequency (see 38.213, section 12) |
| ***subcarrierSpacing***<br>Subcarrier spacing to be used in this BWP for all channels and reference signals unless explicitly configured elsewhere. Corresponds to subcarrier spacing according to 38.211, Table 4.2-1. The value kHz15 corresponds to μ=0, kHz30 to μ=1, and so on. Only the values 15, 30, or 60 kHz (<6GHz), and 60 or 120 kHz (>6GHz) are applicable. For the initial DL BWP this field has the same value as the field subCarrierSpacingCommon in MIB of the same serving cell. |

[240]

[239] TS38.213 V15.3.0, Section 12
[240] TS38.331 V15.3.0

## 5.3 UE channel bandwidth

### 5.3.1 General

The UE channel bandwidth supports a single NR RF carrier in the uplink or downlink at the UE. From a BS perspective, different UE channel bandwidths may be supported within the same spectrum for transmitting to and receiving from UEs connected to the BS. Transmission of multiple carriers to the same UE (CA) or multiple carriers to different UEs within the BS channel bandwidth can be supported.

From a UE perspective, the UE is configured with one or more BWP / carriers, each with its own UE channel bandwidth. The UE does not need to be aware of the BS channel bandwidth or how the BS allocates bandwidth to different UEs.

The placement of the UE channel bandwidth for each UE carrier is flexible but can only be completely within the BS channel bandwidth.

### 5.3.2 Maximum transmission bandwidth configuration

The maximum transmission bandwidth configuration $N_{RB}$ for each UE channel bandwidth and subcarrier spacing is specified in Table 5.3.2-1.

**Table 5.3.2-1: Maximum transmission bandwidth configuration $N_{RB}$**

| SCS (kHz) | 5MHz | 10MHz | 15MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ | $N_{RB}$ |
| 15 | 25 | 52 | 79 | 106 | 133 | 160 | 216 | 270 | N/A | N/A | N/A | N/A |
| 30 | 11 | 24 | 38 | 51 | 65 | 78 | 106 | 133 | 162 | 217 | 245 | 273 |
| 60 | N/A | 11 | 18 | 24 | 31 | 38 | 51 | 65 | 79 | 107 | 121 | 135 |

[241]

#### 5.1.2.2.2 Downlink resource allocation type 1

In downlink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved or interleaved virtual resource blocks within the active bandwidth part of size $N_{\mathrm{BWP}}^{size}$ PRBs except for the case when DCI format 1_0 is decoded in any common search space in which case the size of CORESET 0 shall be used.

A downlink type 1 resource allocation field consists of a resource indication value ($RIV$) corresponding to a starting virtual resource block ( $RB_{start}$ ) and a length in terms of contiguously allocated resource blocks $L_{RBs}$ . The resource indication value is defined by

if $(L_{RBs} - 1) \le \lfloor N_{BWP}^{size} / 2 \rfloor$ then

$$RIV = N_{BWP}^{size}(L_{RBs} - 1) + RB_{start}$$

else

$$RIV = N_{BWP}^{size}(N_{BWP}^{size} - L_{RBs} + 1) + (N_{BWP}^{size} - 1 - RB_{start})$$

where $L_{RBs} \ge 1$ and shall not exceed $N_{BWP}^{size} - RB_{start}$ .

[242]

262. The Accused Products are each a UE wherein location of the first subband in

[241] TS38.101 V15.3.0, Section 5.3
[242] TS38.214 V15.3.0, Section 5.1

frequency domain is used for determining the X time intervals. For example, the location of the first subband in frequency domain (*e.g.*, pdcch-ConfigSIB1) and subcarrier spacing of subcarriers (*e.g.*, subcarrierSpacingCommon) included in the first subband (*e.g.*, BWP) are used for determining X time intervals (*e.g.*, firstPDCCH-MonitoringOccasionOfPO).

## 7.1 Discontinuous Reception for paging

The PDCCH monitoring occasions for paging are determined according to *pagingSearchSpace* as specified in TS 38.213 [4] and *firstPDCCH-MonitoringOccasionOfPO* if configured as specified in TS 38.331 [3]. When *SearchSpaceId* = 0 is configured for *pagingSearchSpace*, the PDCCH monitoring occasions for paging are same as for RMSI as defined in clause 13 in TS 38.213 [4].

When *SearchSpaceId* = 0 is configured for *pagingSearchSpace*, Ns is either 1 or 2. For Ns = 1, there is only one PO which starts from the first PDCCH monitoring occasion for paging in the PF. For Ns = 2, PO is either in the first half frame (i_s = 0) or the second half frame (i_s = 1) of the PF.

When *SearchSpaceId* other than 0 is configured for *pagingSearchSpace,* the UE monitors the $(i_s + 1)^{th}$ PO. A PO is a set of 'S' consecutive PDCCH monitoring occasions where 'S' is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in *SIB1*. The $K^{th}$ PDCCH monitoring occasion for paging in the PO corresponds to the $K^{th}$ transmitted SSB. The PDCCH monitoring occasions for paging which do not overlap with UL symbols (determined according to *tdd-UL-DL-ConfigurationCommon*) are sequentially numbered from zero starting from the first PDCCH monitoring occasion for paging in the PF. When *firstPDCCH-MonitoringOccasionOfPO* is present, the starting PDCCH monitoring occasion number of $(i_s + 1)^{th}$ PO is the $(i_s + 1)^{th}$ value of the *firstPDCCH-MonitoringOccasionOfPO* parameter; otherwise, it is equal to i_s * S.

[243]

### 6.3.2 Radio resource control information elements

```
firstPDCCH-MonitoringOccasionOfPO   CHOICE {
    sCS15KHZoneT                                                          SEQUENCE (SIZE (1..4)) OF INTEGER (0..139),
    sCS30KHZoneT-SCS15KHZhalfT                                            SEQUENCE (SIZE (1..4)) OF INTEGER (0..279),
    sCS60KHZoneT-SCS30KHZhalfT-SCS15KHZquarterT                           SEQUENCE (SIZE (1..4)) OF INTEGER (0..559),
    sCS120KHZoneT-SCS60KHZhalfT-SCS30KHZquarterT-SCS15KHZoneEighthT       SEQUENCE (SIZE (1..4)) OF INTEGER (0..1119),
    sCS120KHZhalfT-SCS60KHZquarterT-SCS30KHZoneEighthT-SCS15KHZoneSixteenthT   SEQUENCE (SIZE (1..4)) OF INTEGER (0..2239),
    sCS120KHZquarterT-SCS60KHZoneEighthT-SCS30KHZoneSixteenthT            SEQUENCE (SIZE (1..4)) OF INTEGER (0..4479),
    sCS120KHZoneEighthT-SCS60KHZoneSixteenthT                             SEQUENCE (SIZE (1..4)) OF INTEGER (0..8959),
    sCS120KHZoneSixteenthT                                                SEQUENCE (SIZE (1..4)) OF INTEGER (0..17919)
```

[244]

263. The Accused Products are each a UE wherein location of the first subband in frequency domain is used for determining the X time intervals. For example, the location of the first subband in frequency domain (e.g., pdcch-ConfigSIB1) and subcarrier spacing of subcarriers (e.g., subcarrierSpacingCommon) included in the first subband (e.g., BWP) are used for determining X time intervals (e.g., firstPDCCH-MonitoringOccasionOfPO). For example, in

[243] TS38.304 V15.3.0, Section 7.1
[244] TS38.331 V15.3.0

identifying the time interval of a subband, the subcarrier spacing information is sufficient to determine the time interval. The standard includes a disclosure that the subcarrier spacing information provided by μ can be used to derive subband location (e.g., BWP) with respect to a common resource block (e.g., CRB0).245 For example, subcarrier spacing information (e.g., subcarrierSpacingCommon) is already included in the MIB information element (*such as the second radio signal*) and can be transmitted from network to UE in BCH/BCCH channel (*such as the claimed second radio signal*).

6.2.2 Message definitions

– *MIB*

The *MIB* includes the system information transmitted on BCH.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: BCCH

Direction: Network to UE

***MIB***

```
-- ASN1START
-- TAG-MIB-START

MIB ::=                             SEQUENCE {
    systemFrameNumber                   BIT STRING (SIZE (6)),
    subCarrierSpacingCommon             ENUMERATED {scs15or60, scs30or120},
    ssb-SubcarrierOffset                INTEGER (0..15),
    dmrs-TypeA-Position                 ENUMERATED {pos2, pos3},
    pdcch-ConfigSIB1                    PDCCH-ConfigSIB1,
    cellBarred                          ENUMERATED {barred, notBarred},
    intraFreqReselection                ENUMERATED {allowed, notAllowed},
    spare                               BIT STRING (SIZE (1))
}

-- TAG-MIB-STOP
-- ASN1STOP
```

245 https://www.sharetechnote.com/html/5G/5G_ResourceGrid.html; https://www.rfwireless-world.com/5G/5G-NR-Resource-Grid-vs-Resource-Block-vs-Resource-Element.html

| MIB field descriptions |
|---|
| ***cellBarred***<br>barred means the cell is barred, as defined in TS 38.304 [20]. |
| ***dmrs-TypeA-Position***<br>Position of (first) DM-RS for downlink (see 38.211, section 7.4.1.1.1) and uplink (see 38.211, section 6.4.1.1.3). |
| ***intraFreqReselection***<br>Controls cell selection/reselection to intra-frequency cells when the highest ranked cell is barred, or treated as barred by the UE, as specified in TS 38.304 [20]. |
| ***pdcch-ConfigSIB1***<br>See TS 38.213 [13]. Determines a common *ControlResourceSet* (CORESET) a common search space and necessary PDCCH parameters. If the field *ssb-SubcarrierOffset* indicates that *SIB1* is not present, the field *pdcch-ConfigSIB1* indicate the frequency positions where the UE may find SS/PBCH block with *SIB1* or the frequency range where the network does not provide SS/PBCH block with *SIB1* (see TS 38.213 [13], section 13). |
| ***ssb-SubcarrierOffset***<br>Corresponds to $k_{SSB}$ (see TS 38.213 [13]), which is the frequency domain offset between SSB and the overall resource block grid in number of subcarriers. (See 38.211).<br>The value range of this field may be extended by an additional most significant bit encoded within PBCH as specified in 38.213 [13].<br>This field may indicate that this beam does not provide *SIB1* and that there is hence no common CORESET (see TS 38.213 [13], section 13). In this case, the field *pdcch-ConfigSIB1* may indicate the frequency positions where the UE may (not) find a SS/PBCH with a control resource set and search space for SIB1 (see 38.213 [13], section 13). |
| ***subCarrierSpacingCommon***<br>Subcarrier spacing for SIB1, Msg.2/4 for initial access and broadcast SI-messages. If the UE acquires this MIB on a carrier frequency <6GHz, the value *scs15or60* corresponds to 15 Khz and the value *scs30or120* corresponds to 30 kHz. If the UE acquires this MIB on a carrier frequency >6GHz, the value *scs15or60* corresponds to 60 Khz and the value *scs30or120* corresponds to 120 kHz. |
| ***systemFrameNumber***<br>The 6 most significant bit (MSB) of the 10-bit System Frame Number. The 4 LSB of the SFN are conveyed in the PBCH transport block as part of channel coding (i.e. outside the MIB encoding). |

[246]

264. For example, the BWP information element comprises: 1) locationAndBandwidth; and 2) subcarrier spacing.

### 6.3.2 Radio resource control information elements

– *BWP*

The *BWP* IE is used to configure a bandwidth part as defined in 38.211, section 4.2.2.

For each serving cell the network configures at least an initial bandwidth part comprising of at least a downlink bandwidth part and one (if the serving cell is configured with an uplink) or two (if using supplementary uplink (SUL)) uplink bandwidth parts. Furthermore, the network may configure additional uplink and downlink bandwidth parts for a serving cell.

The bandwidth part configuration is split into uplink and downlink parameters and into common and dedicated parameters. Common parameters (in BWP-UplinkCommon and BWP-DownlinkCommon) are "cell specific" and the network ensures the necessary alignment with corresponding parameters of other UEs. The common parameters of the initial bandwidth part of the PCell are also provided via system information. For all other serving cells, the network provides the common parameters via dedicated signalling.

**BWP information element**

```
-- ASN1START
-- TAG-BANDWIDTH-PART-START

BWP ::=                         SEQUENCE {
    locationAndBandwidth            INTEGER (0..37949),
    subcarrierSpacing               SubcarrierSpacing,
    cyclicPrefix                    ENUMERATED { extended }                    OPTIONAL    -- Need R
}


-- TAG-BANDWIDTH-PART-STOP
-- ASN1STOP
```

| BWP field descriptions |
|---|
| ***cyclicPrefix***<br>Indicates whether to use the extended cyclic prefix for this bandwidth part. If not set, the UE uses the normal cyclic prefix. Normal CP is supported for all numerologies and slot formats. Extended CP is supported only for 60 kHz subcarrier spacing. (see 38.211, section 4.2.2) |
| ***locationAndBandwidth***<br>Frequency domain location and bandwidth of this bandwidth part. The value of the field shall be interpreted as resource indicator value (RIV) as defined TS 38.214 with assumptions as described in TS 38.213, section 12, i.e. setting $N_{BWP}^{size}$=275. The first PRB is a PRB determined by subcarrierSpacing of this BWP and offsetToCarrier (configured in SCS-SpecificCarrier contained within FrequencyInfoDL / FrequencyInfoUL) corresponding to this subcarrier spacing. In case of TDD, a BWP-pair (UL BWP and DL BWP with the same bwp-Id) must have the same center frequency (see 38.213, section 12) |
| ***subcarrierSpacing***<br>Subcarrier spacing to be used in this BWP for all channels and reference signals unless explicitly configured elsewhere. Corresponds to subcarrier spacing according to 38.211, Table 4.2-1. The value kHz15 corresponds to μ=0, kHz30 to μ=1, and so on. Only the values 15, 30, or 60 kHz (<6GHz), and 60 or 120 kHz (>6GHz) are applicable. For the initial DL BWP this field has the same value as the field subCarrierSpacingCommon in MIB of the same serving cell. |

[247]

265. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’581 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others,

[246] TS38.331 V15.3.0, Section 6.2.2

[247] TS38.331 V15.3.0, Section 6.3.2

such as Defendant's customers and end-users, in this District and elsewhere in the United States. For example, Defendant's customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the '581 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[248] Because of Defendant's inducement, Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '581 Patent. Defendant performs these affirmative acts with knowledge of the '581 Patent and with the intent, or willful blindness, that the induced acts directly infringe the '581 Patent.

266. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '581 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant's affirmative acts of selling and offering to sell the Accused Products in this District and elsewhere in the United States and causing the Accused Products to be manufactured, used, sold, and offered for sale contribute to others' use and manufacture of the Accused Products such

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[248] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier.

that the ’581 Patent is directly infringed by others. The accused components within the Accused Products including, but not limited to, chipsets manufactured by Defendant, are material to the invention of the ’581 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the ’581 Patent. Defendant performs these affirmative acts with knowledge of the ’581 Patent and with intent, or willful blindness, that they cause the direct infringement of the ’581 Patent.

267. ABT has suffered damages as a result of Defendant’’ direct and indirect infringement of the ’581 Patent in an amount to be proved at trial.

268. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant’s infringement of the ’581 Patent, for which there is no adequate remedy at law, unless Defendant’s infringement is enjoined by this Court.

269. On information and belief, Defendant acted egregiously and with willful misconduct in that their actions constituted direct or indirect infringement of a valid patent, and this was either known or so obvious that Defendant should have known about it. Defendant continue to infringe the ’581 Patent by making, using, selling, offering for sale and/or importing in the United States the Accused Products and by inducing the direct infringing use, sale, offer for sale, and importation of the Accused Products by others, in reckless disregard of ABT’s patent rights. Defendant has committed and continue to commit acts of infringement that Defendant actually knew or should have known constituted an unjustifiably high risk of infringement of at least one valid and enforceable claim of the ’581 Patent. Upon information and belief, Defendant had actual knowledge of the ’581 Patent from related prior litigations accusing either the same products involving Defendant and products with similar 5G functionalities involving direct

competitors of Defendant. Defendant's infringement of the '581 Patent has been and continues to be willful, entitling ABT to an award of treble damages, reasonable attorney fees, and costs in bringing this action under 35 U.S.C. §§ 284 and 285.

**COUNT XIV**
**(Infringement of the '434 Patent)**

270. The preceding paragraphs are incorporated by reference as if fully set forth herein.

271. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the '434 Patent.

272. Defendant has and continues to directly infringe the '434 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by using the Accused Products to perform the claimed method(s) of the '434 Patent. Such products include at least Accused Products including, but not limited to, Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which practice a method comprising: receiving, by a wireless device; a first configuration parameter used in determination of a first sequence of one or more bits for downlink control information (DCI) validation; a second configuration parameter used in determination of a second sequence of one or more bits for DCI validation; and a third configuration parameter indicating a configuration index of an uplink configured grant configuration; receiving a DCI comprising: a hybrid automatic repeat request process number field comprising one or more first bits; and a redundancy version field comprising one or more second bits; validating the DCI: based

on comparing the one or more second bits with the second sequence and not based on the one or more first bits in response to the one or more first bits indicating the configuration index; and based on comparing the one or more second bits with the second sequence and comparing the one or more first bits with the first sequence in response to the one or more first bits not indicating the configuration index; and activating or deactivating resources associated with the uplink configured grant configuration.

273. For example, Defendant has and continue to directly infringe at least claim 1 of the '434 Patent by using products that implement the 5G standards, such as the Accused Products (*e.g.*, 5G mobile handsets and tablets) to perform the claimed method(s).

274. For example, the Accused Products practice a method comprising: receiving, by a wireless device.249

275. For example, the Accused Products practice a method where a first configuration parameter is used in determination of a first sequence of one or more bits for downlink control information (DCI) validation (*e.g.*, a harq-ProcessNumberSizeDCI-0-2 configuration parameter "configure[s] the number of bits for the field "HARQ process number" in DCI format 0_2").250

276. For example, the Accused Products practice a method where a second configuration parameter is used in determination of a second sequence of one or more bits for DCI validation (*e.g.*, a numberOfBitsRV-DCI-0-2 configuration parameter "configures the number of bits for "Redundancy version" in the DCI format 0_2").[251]

277. For example, the Accused Products practice a method where a third configuration parameter indicating a configuration index of an uplink (e.g., configuredGrantConfigIndex-r16 is

[249] *See* TS 38.331 V16.5.0, Sections 5.1.2, 6.3.2.
[250] *Id.*; TS 38.212 V16.6.0, Section 7.3.1; TS 38.213 V16.6.0, Section 10.2.
[251] *Id.*

a third configuration parameter that "indicates the index of the Configured Grant configuration within the BWP" or Bandwidth Part).[252]

278. For example, the Accused Products practice receiving a DCI comprising: a hybrid automatic repeat request process number field comprising one or more first bits (*e.g.*, downlink control channel information includes a "HARQ process number" field that is a hybrid automatic repeat request process number field).[253]

279. For example, the Accused Products practice receiving a DCI comprising: a redundancy version field comprising one or more second bits (*e.g.*, downlink control channel information includes a "Redundancy version" field).[254]

280. For example, the Accused Products practice validating the DCI: based on comparing the one or more second bits with the second sequence and not based on the one or more first bits in response to the one or more first bits indicating the configuration index (e.g., validating the DCI is based on the DCI format using multiple configured grant configurations, because under the multiple configured grant configurations (when a UE is provided multiple UL grant Type 2 configurations), only the "redundancy version" field corresponding to the second bits is compared with the second sequence).[255]

281. For example, the Accused Products practice validating the DCI: based on comparing the one or more second bits with the second sequence and comparing the one or more first bits with the first sequence in response to the one or more first bits not indicating the configuration index (*e.g.*, validating the DCI is based on the DCI format using single configured

---

[252] *Id.*
[253] *See* TS 38.321 V16.5.0, Section 5.4.1; TS 38.212 V16.6.0, Sections 4.2, 7.3.1.
[254] *Id.*
[255] *See* TS 38.213 V16.6.0, Section 10.2; TS 38.331 V16.5.0, Section 6.3.2.

grant configurations, because under the single configured grant configurations (when a UE is provided a single UL grant Type 2 configuration), both the "HARQ process" field corresponding to the first bits and the "redundancy version" field corresponding to the second bits are compared respectively with the first and second sequence).[256]

282. For example, the Accused Products practice activating or deactivating resources associated with the uplink configured grant configuration (*e.g.*, PDCCH can be used for "activation and deactivation of configured PUSCH transmission with configured grant" and "L1 signalling indicat[es] configured uplink grant activation or deactivation.").257

283. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '434 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant's customers and end-users, in this District and elsewhere in the United States. For example, Defendant's customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the '434 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.258 Because of Defendant's inducement,

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[256] *Id.*
[257] *See* TS 38.321 V16.5.0, Sections 5.4.1, 5.8; TS 38.213 V16.6.0, Section 10.2; TS 38.300 V16.6.0, Sections 5.2.3, 10.3.
[258] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/;

Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '434 Patent. Defendant performs these affirmative acts with knowledge of the '434 Patent and with the intent, or willful blindness, that the induced acts directly infringe the '434 Patent.

284. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '434 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant's affirmative acts of selling and offering to sell the Accused Products in this District and elsewhere in the United States and causing the Accused Products to be manufactured, used, sold, and offered for sale contributes to others' use and manufacture of the Accused Products such that the '434 Patent is directly infringed by others. The accused components within the Accused Products including, but not limited to, chipsets manufactured by Defendant, are material to the invention of the '434 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the '434 Patent. Defendant performs these affirmative acts with knowledge of the '434 Patent and with intent, or willful blindness, that they cause the direct infringement of the '434 Patent.

285. Defendant, with knowledge that these products, or the use thereof, infringe the '434 Patent at least as of the date of the original Complaint in this case dated November 30, 2021, knowingly and intentionally induced, and continue to knowingly and intentionally induce direct

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https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

infringement of the ’434 Patent by providing these products to end-users for use in an infringing manner.

286. ABT has suffered damages as a result of Defendant’s direct and indirect infringement of the ’434 Patent in an amount to be proved at trial.

287. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant’s infringement of the ’434 Patent, for which there is no adequate remedy at law, unless Defendant’s infringement is enjoined by this Court.

288. On information and belief, Defendant acted egregiously and with willful misconduct in that their actions constituted direct or indirect infringement of a valid patent, and this was either known or so obvious that Defendant should have known about it. Defendant continues to infringe the ’434 Patent by using the Accused Products to perform the claimed method(s) and by inducing the direct infringing use, sale, offer for sale, and importation of the Accused Products by others, in reckless disregard of ABT’s patent rights. Defendant has committed and continue to commit acts of infringement that Defendant actually knew or should have known constituted an unjustifiably high risk of infringement of at least one valid and enforceable claim of the ’434 Patent. Upon information and belief, Defendant had actual knowledge of the ’434 Patent from related prior litigations accusing either the same products involving Defendant and products with similar 5G functionalities involving direct competitors of Defendant. Defendant’s infringement of the ’434 Patent has been and continues to be willful, entitling ABT to an award of treble damages, reasonable attorney fees, and costs in bringing this action under 35 U.S.C. §§ 284 and 285.

## COUNT XV
## (Infringement of the ’944 Patent)

289. The preceding paragraphs are incorporated by reference as if fully set forth herein.

290. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the ’944 Patent.

291. Defendant has and continues to directly infringe the ’944 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the ’944 Patent. Such products include at least Accused Products including, but not limited to, Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which each are a wireless device comprising: one or more processors; and memory storing instructions that, when executed by the one or more processors, cause the wireless device to: receive a downlink control information (DCII comprising: a hybrid automatic repeat request process number field comprising one or more first bits; and a redundancy version field comprising one or more second bits; validate the DCI, wherein the validating: is based on the one or more second bits; is based on comparing the one or more first bits with a first sequence of one or more bits, determined using a first configuration parameter, in response to: the one or more first bits not indicating a configuration index; and the DCI having a first format; is not based on comparing the one or more first bits with the first sequence in response to the DCI having a second format; and is not based on the one or more first bits in response to the one or more first bits indicating a configuration index; and activate or deactivate resources.

292. For example, Defendant has and continues to directly infringe at least claim 11 of the ’944 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards such as the Accused Products (*e.g.*, 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware for implementing 3rd Generation Partnership Product (3GPP) specifications).

293. For example, the Accused Products receive a downlink control information (DCI comprising: a hybrid automatic repeat request process number field comprising one or more first bits; and a redundancy version field comprising one or more second bits. For further example, the “HARQ process number” field is the claimed hybrid automatic repeat request process number field and the “Redundancy version” field is the claimed redundancy version field.

5.3.1 DL Assignment reception

...

1> else if a downlink assignment for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

…

2> if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate SPS deactivation:

…

3> else if PDCCH content indicates SPS activation:

... [259]

5.4.1 UL Grant reception

...

1> else if an uplink grant for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

….

2> else if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate configured grant Type 2 deactivation:

…

3> else if PDCCH contents indicate configured grant Type 2 activation: [260]

[259] TS 38.321 V16.5.0, Section 5.3.1
[260] TS 38.321 V16.5.0, Section 5.4.1

# 4 Mapping to physical channels

...

## 4.2 Downlink

... Table 4.2-2 specifies the mapping of the downlink control channel information to its corresponding physical channel.

...

**Table 4.2-2**

| **Control information** | **Physical Channel** |
|---|---|
| DCI | PDCCH |

... [261]

[261] TS 38.212 V16.6.0, Section 4.2

7.3.1.1.1 Format 0_0

DCI format 0_0 is used for the scheduling of PUSCH in one cell.
The following information is transmitted by means of the DCI format 0_0 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

...

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2
- HARQ process number – 4 bits, reserved

...

7.3.1.1.2 Format 0_1

DCI format 0_1 is used for the scheduling of one or multiple PUSCH in one cell, or indicating CG downlink feedback information (CG-DFI) to a UE.
The following information is transmitted by means of the DCI format 0_1 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or MCS-C-RNTI:

...

- Redundancy version – – number of bits determined by the following:
- 2 bits as defined in Table 7.3.1.1.1-2 if the number of scheduled PUSCH indicated by the Time domain resource assignment field is 1;
- otherwise 2, 3, 4, 5, 6, 7 or 8 bits determined by the maximum number of schedulable PUSCHs among all entries in the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH*, where each bit corresponds to one scheduled PUSCH as defined in clause 6.1.4 in [6, TS 38.214] and redundancy version is determined according to Table 7.3.1.1.2-34.
- HARQ process number – 4 bits

...

7.3.1.1.3 Format 0_2

DCI format 0_2 is used for the scheduling of PUSCH in one cell.
The following information is transmitted by means of the DCI format 0_2 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or MCS-C-RNTI:

...

- Redundancy version – 0, 1 or 2 bits determined by higher layer parameter *numberOfBitsForRV-DCI-0-2*

...

- HARQ process number – 0, 1, 2, 3 or 4 bits determined by higher layer parameter *harq-ProcessNumberSizeDCI-0-2*

...

[262]

[262] TS 38.212 V16.6.0, Section 7.3.1

7.3.1.2.1 Format 1_0

DCI format 1_0 is used for the scheduling of PDSCH in one DL cell.

The following information is transmitted by means of the DCI format 1_0 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

...

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2
- HARQ process number – 4 bits

...

7.3.1.2.2 Format 1_1

DCI format 1_1 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1_1 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

...

For transport block 1:

...

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

For transport block 2 (only present if *maxNrofCodeWordsScheduledByDCI* equals 2):

...

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

...

- HARQ process number – 4 bits

...

7.3.1.2.3 Format 1_2

DCI format 1_2 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1_2 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

...

- Redundancy version – 0, 1 or 2 bits determined by higher layer parameter *numberOfBitsForRV-DCI-1-2*

...

- HARQ process number – 0, 1, 2, 3 or 4 bits determined by higher layer parameter *harq-ProcessNumberSizeDCI-1-2* [263]

294. For example, the Accused Products validate the DCI, wherein the validating is based on the one or more second bits.

[263] *Id.*

## 10.2 PDCCH validation for DL SPS and UL grant Type 2

A UE validates, for scheduling activation or scheduling release, a DL SPS assignment PDCCH or a configured UL grant Type 2 PDCCH ...

If a UE is provided a single configuration for UL grant Type 2 PUSCH or for SPS PDSCH, validation of the DCI format is achieved if all fields for the DCI format are set according to Table 10.2-1 or Table 10.2-2.

If a UE is provided more than one configurations for UL grant Type 2 PUSCH or for SPS PDSCH, a value of the HARQ process number field in a DCI format indicates an activation for a corresponding UL grant Type 2 PUSCH or for a SPS PDSCH configuration with a same value as provided by *ConfiguredGrantConfigIndex* or by *sps-ConfigIndex*, respectively. Validation of the DCI format is achieved if the RV field for the DCI format is set as in Table 10.2-3.

If a UE is provided more than one configuration for UL grant Type 2 PUSCH or for SPS PDSCH

- if the UE is provided *ConfiguredGrantConfigType2DeactivationStateList* or *sps-ConfigDeactivationStateList*, a value of the HARQ process number field in a DCI format indicates a corresponding entry for scheduling release of one or more UL grant Type 2 PUSCH or SPS PDSCH configurations

- if the UE is not provided *ConfiguredGrantConfigType2DeactivationStateList* or *sps-ConfigDeactivationStateList*, a value of the HARQ process number field in a DCI format indicates a release for a corresponding UL grant Type 2 PUSCH or for a SPS PDSCH configuration with a same value as provided by *ConfiguredGrantConfigIndex* or by *sps-ConfigIndex*, respectively

Validation of the DCI format is achieved if all fields for the DCI format are set according to Table 10.2-4.

**Table 10.2-1: Special fields for single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell**

| | DCI format 0_0/0_1/0_2 | DCI format 1_0/1_2 | DCI format 1_1 |
|---|---|---|---|
| HARQ process number | set to all '0's | set to all '0's | set to all '0's |
| Redundancy version | set to all '0's | set to all '0's | For the enabled transport block: set to all '0's |

**Table 10.2-2: Special fields for single DL SPS or single UL grant Type 2 scheduling release PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell**

| | DCI format 0_0/0_1/0_2 | DCI format 1_0/1_1/1_2 |
|---|---|---|
| HARQ process number | set to all '0's | set to all '0's |
| Redundancy version | set to all '0's | set to all '0's |
| Modulation and coding scheme | set to all '1's | set to all '1's |
| Frequency domain resource assignment | set to all '0's for FDRA Type 2 with $\mu = 1$<br><br>set to all '1's, otherwise | set to all '0's for FDRA Type 0 or for *dynamicSwitch*<br><br>set to all '1's for FDRA Type 1 |

**Table 10.2-3: Special fields for a single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell**

| | DCI format 0_0/0_1/0_2 | DCI format 1_0/1_2 | DCI format 1_1 |
|---|---|---|---|
| Redundancy version | set to all '0's | set to all '0's | For the enabled transport block: set to all '0's |

**Table 10.2-4: Special fields for a single or multiple DL SPS and UL grant Type 2 scheduling release PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell**

| | DCI format 0_0/0_1/0_2 | DCI format 1_0/1_1/1_2 |
|---|---|---|
| Redundancy version | set to all '0's | set to all '0's |
| Modulation and coding scheme | set to all '1's | set to all '1's |
| Frequency domain resource assignment | set to all '0's for FDRA Type 2 with $\mu = 1$<br><br>set to all '1's, otherwise | set to all '0's for FDRA Type 0 or for *dynamicSwitch*<br><br>set to all '1's for FDRA Type 1 |

[264]

295. For example, the Accused Products validate the DCI, wherein the validating is based on comparing the one or more first bits with a first sequence of one or more bits, determined using a first configuration parameter, in response to: the one or more first bits not indicating a configuration index; and the DCI having a first format. For example, if a UE is provided a single downlink SPS configuration or a single uplink configured grant configuration, the HARQ process number field of DCI does not indicate a configuration index and is used in validation. For further example, the "first format" limitation in the claim is either format 0_2 (for UL configured grant activation/deactivation) or format 1_2 (for DL SPS activation/deactivation). For further example,

[264] TS 38.213 V16.6.0, Section 10.2

the number of ‘0’s in the sequence of all ‘0’s highlighted in Tables 10.2-1 and 10.2-2 for HARQ process number field of DCI format 0_2 is determined using the size of the HARQ process number filed of DCI format 0_2 which is configurable using the harq-ProcessNumberSizeDCI-0-2 configuration parameter (i.e., the first configuration parameter). For further example, the number of ‘0’s in the sequence of all ‘0’s highlighted in Tables 10.2-1 and 10.2-2 for HARQ process number field of DCI format 1_2 is determined using the size of the HARQ process number filed of DCI format 1_2 which is configurable using the harq-ProcessNumberSizeDCI-1-2 configuration parameter (i.e., the first configuration parameter).

10.2 PDCCH validation for DL SPS and UL grant Type 2

A UE validates, for scheduling activation or scheduling release, a DL SPS assignment PDCCH or a configured UL grant Type 2 PDCCH ...

If a UE is provided a single configuration for UL grant Type 2 PUSCH or for SPS PDSCH, validation of the DCI format is achieved if all fields for the DCI format are set according to Table 10.2-1 or Table 10.2-2.

If a UE is provided more than one configurations for UL grant Type 2 PUSCH or for SPS PDSCH, a value of the HARQ process number field in a DCI format indicates an activation for a corresponding UL grant Type 2 PUSCH or for a SPS PDSCH configuration with a same value as provided by *ConfiguredGrantConfigIndex* or by *sps-ConfigIndex*, respectively. Validation of the DCI format is achieved if the RV field for the DCI format is set as in Table 10.2-3.

...

**Table 10.2-1: Special fields for single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell**

| | DCI format 0_0/0_1/0_2 | DCI format 1_0/1_2 | DCI format 1_1 |
|---|---|---|---|
| HARQ process number | set to all '0's | set to all '0's | set to all '0's |
| Redundancy version | set to all '0's | set to all '0's | For the enabled transport block: set to all '0's |

**Table 10.2-2: Special fields for single DL SPS or single UL grant Type 2 scheduling release PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell**

| | DCI format 0_0/0_1/0_2 | DCI format 1_0/1_1/1_2 |
|---|---|---|
| HARQ process number | set to all '0's | set to all '0's |
| Redundancy version | set to all '0's | set to all '0's |
| Modulation and coding scheme | set to all '1's | set to all '1's |
| Frequency domain resource assignment | set to all '0's for FDRA Type 2 with $\mu = 1$<br><br>set to all '1's, otherwise | set to all '0's for FDRA Type 0 or for *dynamicSwitch*<br><br>set to all '1's for FDRA Type 1 |

[265]

## 6.3.2 Radio resource control information elements

...

### – *PDSCH-Config*

The *PDSCH-Config* IE is used to configure the UE specific PDSCH parameters.

```
PDSCH-Config ::= SEQUENCE {
...
harq-ProcessNumberSizeDCI-1-2-r16 INTEGER (0..4)
OPTIONAL, -- Need R
...
```

***harq-ProcessNumberSizeDCI-1-2***

Configure the number of bits for the field "HARQ process number" in DCI format 1_2 (see TS 38.212 [17], clause 7.3.1).

...

### – *PUSCH-Config*

The IE *PUSCH-Config* is used to configure the UE specific PUSCH parameters applicable to a particular BWP.

```
PUSCH-Config ::= SEQUENCE {
...
harq-ProcessNumberSizeDCI-0-2-r16 INTEGER
(0..4) OPTIONAL, -- Need R
...
```

***harq-ProcessNumberSizeDCI-0-2***

Configure the number of bits for the field "HARQ process number" in DCI format 0_2 (see TS 38.212 [17], clause 7.3.1). [266]

[265] TS 38.213 V16.6.0, Section 10.2

[266] TS 38.331 V16.5.0, Section 6.3.2

### 7.3.1.1 DCI formats for scheduling of PUSCH

...

7.3.1.1.3 Format 0_2

DCI format 0_2 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0_2 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or MCS-C-RNTI:

...

- HARQ process number – 0, 1, 2, 3 or 4 bits determined by higher layer parameter *harq-ProcessNumberSizeDCI-0-2*

...

### 7.3.1.2 DCI formats for scheduling of PDSCH

7.3.1.2.3 Format 1_2

DCI format 1_2 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1_2 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

...

- HARQ process number – 0, 1, 2, 3 or 4 bits determined by higher layer parameter *harq-ProcessNumberSizeDCI-1-2* [267]

296. For example, the Accused Products validate the DCI, wherein the validating is not based on comparing the one or more first bits with the first sequence in response to the DCI having a second format. For example, the second format may be any of DCI formats 0_0, 0_1, 1_0, and 1_1. For DCI formats 0_0, 0_1, 1_0, and 1_1, the size of the HARQ process number field is pre-determined (i.e., 4 bits) and is not configurable. The validation (in case of a single configuration) is based on comparing the HARQ process number field with a sequence of all-zeros with a predetermined length. The validation is not based on comparing the HARQ process number field with the first sequence whose length is configurable.

### 10.2 PDCCH validation for DL SPS and UL grant Type 2

A UE validates, for scheduling activation or scheduling release, a DL SPS assignment PDCCH or a configured UL grant Type 2 PDCCH ...

If a UE is provided a single configuration for UL grant Type 2 PUSCH or for SPS PDSCH, validation of the DCI format is achieved if all fields for the DCI format are set according to Table 10.2-1 or Table 10.2-2.

[267] TS 38.331 V16.5.0, Section 7.3.1

**Table 10.2-1: Special fields for single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell**

| | DCI format 0_0/0_1/0_2 | DCI format 1_0/1_2 | DCI format 1_1 |
|---|---|---|---|
| HARQ process number | set to all '0's | set to all '0's | set to all '0's |
| Redundancy version | set to all '0's | set to all '0's | For the enabled transport block: set to all '0's |

**Table 10.2-2: Special fields for single DL SPS or single UL grant Type 2 scheduling release PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell**

| | DCI format 0_0/0_1/0_2 | DCI format 1_0/1_1/1_2 |
|---|---|---|
| HARQ process number | set to all '0's | set to all '0's |
| Redundancy version | set to all '0's | set to all '0's |
| Modulation and coding scheme | set to all '1's | set to all '1's |
| Frequency domain resource assignment | set to all '0's for FDRA Type 2 with $\mu = 1$<br><br>set to all '1's, otherwise | set to all '0's for FDRA Type 0 or for *dynamicSwitch*<br><br>set to all '1's for FDRA Type 1 |

[268]

## 7.3.1.1 DCI formats for scheduling of PUSCH

### 7.3.1.1.1 Format 0_0

DCI format 0_0 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0_0 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

...

- HARQ process number – 4 bits, reserved

...

### 7.3.1.1.2 Format 0_1

DCI format 0_1 is used for the scheduling of one or multiple PUSCH in one cell, or indicating CG downlink feedback information (CG-DFI) to a UE.

The following information is transmitted by means of the DCI format 0_1 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or MCS-C-RNTI:

...

- HARQ process number – 4 bits

...

## 7.3.1.2 DCI formats for scheduling of PDSCH

### 7.3.1.2.1 Format 1_0

DCI format 1_0 is used for the scheduling of PDSCH in one DL cell.

The following information is transmitted by means of the DCI format 1_0 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

...

- HARQ process number – 4 bits

...

[268] TS 38.213 V16.6.0, Section 10.2

7.3.1.2.2 Format 1_1
DCI format 1_1 is used for the scheduling of PDSCH in one cell.
The following information is transmitted by means of the DCI format 1_1
with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:
...
- HARQ process number – 4 bits [269]

297. For example, the Accused Products validate the DCI, wherein the validating is not based on the one or more first bits in response to the one or more first bits indicating a configuration index. For example, when multiple UL configured grant configurations are configured, the HARQ process number field of DCI indicates a configuration index for a corresponding configured grant configuration (either directly or through a deactivation state) and validation is based on Tables 10.2-3 and 10.2-4 and is not based on the HARQ process number field of DCI. For further example, multiple DL SPS configurations are configured, the HARQ process number field of DCI indicates a configuration index for a corresponding DL SPS configuration (either directly or through a deactivation state) and validation is based on Tables 10.2-3 and 10.2-4 and is not based on the HARQ process number field of DCI.

[269] TS 38.212 V16.6.0, Section 7.3.1

## 10.2 PDCCH validation for DL SPS and UL grant Type 2

A UE validates, for scheduling activation or scheduling release, a DL SPS assignment PDCCH or a configured UL grant Type 2 PDCCH ...

If a UE is provided more than one configurations for UL grant Type 2 PUSCH or for SPS PDSCH, a value of the HARQ process number field in a DCI format indicates an activation for a corresponding UL grant Type 2 PUSCH or for a SPS PDSCH configuration with a same value as provided by *ConfiguredGrantConfigIndex* or by *sps-ConfigIndex*, respectively. Validation of the DCI format is achieved if the RV field for the DCI format is set as in Table 10.2-3.

If a UE is provided more than one configuration for UL grant Type 2 PUSCH or for SPS PDSCH

- if the UE is provided *ConfiguredGrantConfigType2DeactivationStateList* or *sps-ConfigDeactivationStateList*, a value of the HARQ process number field in a DCI format indicates a corresponding entry for scheduling release of one or more UL grant Type 2 PUSCH or SPS PDSCH configurations

- if the UE is not provided *ConfiguredGrantConfigType2DeactivationStateList* or *sps-ConfigDeactivationStateList*, a value of the HARQ process number field in a DCI format indicates a release for a corresponding UL grant Type 2 PUSCH or for a SPS PDSCH configuration with a same value as provided by *ConfiguredGrantConfigIndex* or by *sps-ConfigIndex*, respectively

Validation of the DCI format is achieved if all fields for the DCI format are set according to Table 10.2-4.

...

**Table 10.2-3: Special fields for a single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell**

| | DCI format 0_0/0_1/0_2 | DCI format 1_0/1_2 | DCI format 1_1 |
|---|---|---|---|
| Redundancy version | set to all '0's | set to all '0's | For the enabled transport block: set to all '0's |

**Table 10.2-4: Special fields for a single or multiple DL SPS and UL grant Type 2 scheduling release PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell**

| | DCI format 0_0/0_1/0_2 | DCI format 1_0/1_1/1_2 |
|---|---|---|
| Redundancy version | set to all '0's | set to all '0's |
| Modulation and coding scheme | set to all '1's | set to all '1's |
| Frequency domain resource assignment | set to all '0's for FDRA Type 2 with $\mu = 1$<br><br>set to all '1's, otherwise | set to all '0's for FDRA Type 0 or for *dynamicSwitch*<br><br>set to all '1's for FDRA Type 1 |

[270]

[270] TS 38.213 V16.6.0, Section 10.2

6.3.2 Radio resource control information elements

...

### – *BWP-DownlinkDedicated*

The IE *BWP-DownlinkDedicated* is used to configure the dedicated (UE specific) parameters of a downlink BWP.

```
BWP-DownlinkDedicated ::= SEQUENCE {
...
sps-ConfigDeactivationStateList-r16 SPSConfigDeactivationStateList-
r16 OPTIONAL,
-- Need R
...
}
...
SPS-ConfigDeactivationState-r16 ::= SEQUENCE (SIZE (1..maxNrofSPSConfig-
r16)) OF SPS-ConfigIndex-r16

SPS-ConfigDeactivationStateList-r16 ::= SEQUENCE (SIZE (1..maxNrofSPSDeactivationState))
OF SPS-ConfigDeactivationState-r16
```

***sps-ConfigDeactivationStateList***

Indicates a list of the deactivation states in which each state can be mapped to a single or multiple SPS configurations to be deactivated, see clause 10.2 in TS 38.213 [13]. If a state is mapped to multiple SPS configurations, each of these SPS configurations is configured with the same *harq-CodebookID*.

### – *SPS-ConfigIndex*

The IE *SPS-ConfigIndex* is used to indicate the index of one of multiple DL SPS configurations in one BWP.

**SPS-ConfigIndex information element**

```
SPS-ConfigIndex-r16 ::= INTEGER (0.. maxNrofSPS-Config-r16-
1)
```

### – *BWP-UplinkDedicated*

The IE *BWP-UplinkDedicated* is used to configure the dedicated (UE specific) parameters of an uplink BWP.

```
BWP-UplinkDedicated ::= SEQUENCE {
...

configuredGrantConfigType2DeactivationStateList-r16
ConfiguredGrantConfigType2DeactivationStateList-r16 OPTIONAL --
Need R
]]
}
...
ConfiguredGrantConfigType2DeactivationState-r16 ::= SEQUENCE (SIZE
(1..maxNrofConfiguredGrantConfig-r16)) OF ConfiguredGrantConfigIndexr16
ConfiguredGrantConfigType2DeactivationStateList-r16 ::=
SEQUENCE (SIZE (1..maxNrofCGType2DeactivationState))
OF ConfiguredGrantConfigType2DeactivationState-r16
```

***configuredGrantConfigType2DeactivationStateList***

Indicates a list of the deactivation states in which each state can be mapped to a single or multiple Configured Grant type 2 configurations to be deactivated when the corresponding deactivation DCI is received, see clause 7.3.1 in TS 38.212 [17] and clause 10.2 in TS 38.213 [13].

– *ConfiguredGrantConfigIndex*

The IE *ConfiguredGrantConfigIndex* is used to indicate the index of one of multiple UL Configured Grant configurations in one BWP.

```
ConfiguredGrantConfigIndex-r16 ::= INTEGER (0..
maxNrofConfiguredGrantConfig-r16-1)
```

[271]

298. For example, the Accused Products activate or deactivate resources.

5.3.1 DL Assignment reception

...

When the MAC entity has a C-RNTI, Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion during which it monitors PDCCH and for each Serving Cell:

...

1> else if a downlink assignment for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

...

2> if the NDI in the received HARQ information is 0:
3> if PDCCH contents indicate SPS deactivation:
4> clear the configured downlink assignment for this Serving Cell (if any);

...

3> else if PDCCH content indicates SPS activation:
4> store the downlink assignment for this Serving Cell and the associated HARQ information as configured downlink assignment;
4> initialise or re-initialise the configured downlink assignment for this Serving Cell to start in the associated PDSCH duration and to recur according to rules in clause 5.8.1;

[272]

5.4.1 UL Grant reception

...

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

...

1> else if an uplink grant for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

...

2> else if the NDI in the received HARQ information is 0:
3> if PDCCH contents indicate configured grant Type 2 deactivation:

...

3> else if PDCCH contents indicate configured grant Type 2 activation:

...

4> store the uplink grant for this Serving Cell and the associated HARQ information as configured uplink grant;
4> initialise or re-initialise the configured uplink grant for this Serving Cell to start in the associated PUSCH duration and to recur according to rules in clause 5.8.2;

....

[273]

[271] TS 38.331 V16.5.0, Section 6.3.2
[272] TS 38.321 V16.5.0, Section 5.3.1
[273] TS 38.321 V16.5.0, Section 5.4.1

## 5.8 Transmission and reception without dynamic scheduling

### 5.8.1 Downlink

Semi-Persistent Scheduling (SPS) is configured by RRC for a Serving Cell per BWP. Multiple assignments can be active simultaneously in the same BWP. Activation and deactivation of the DL SPS are independent among the Serving Cells.

For the DL SPS, a DL assignment is provided by PDCCH, and stored or cleared based on L1 signalling indicating SPS activation or deactivation.

...

### 5.8.2 Uplink

There are two types of transmission without dynamic grant:

- configured grant Type 1 where an uplink grant is provided by RRC, and stored as configured uplink grant;
- configured grant Type 2 where an uplink grant is provided by PDCCH, and stored or cleared as configured uplink grant based on L1 signalling indicating configured uplink grant activation or deactivation. [274]

## 10.2 PDCCH validation for DL SPS and UL grant Type 2

...

If validation is achieved, the UE considers the information in the DCI format as a valid activation or valid release of DL SPS or configured UL grant Type 2.

If validation is not achieved, the UE discards all the information in the DCI format. [275]

[274] TS 38.321 V16.5.0, Section 5.8

[275] TS 38.213 V16.6.0, Section 10.2

5.2.3 Physical downlink control channels

...

In addition to scheduling, PDCCH can be used to for

- Activation and deactivation of configured PUSCH transmission with configured grant;
- Activation and deactivation of PDSCH semi-persistent transmission; [276]

10.2 Downlink Scheduling

...

In addition, with Semi-Persistent Scheduling (SPS), the gNB can allocate downlink resources for the initial HARQ transmissions to UEs: RRC defines the periodicity of the configured downlink assignments while PDCCH addressed to CS-RNTI can either signal and activate the configured downlink assignment, or deactivate it; i.e. a PDCCH addressed to CS-RNTI indicates that the downlink assignment can be implicitly reused according to the periodicity defined by RRC, until deactivated. [277]

10.3 Uplink Scheduling

...

In addition, with Configured Grants, the gNB can allocate uplink resources for the initial HARQ transmissions and HARQ retransmissions to UEs. Two types of configured uplink grants are defined:

- With Type 1, RRC directly provides the configured uplink grant (including the periodicity).
- With Type 2, RRC defines the periodicity of the configured uplink grant while PDCCH addressed to CS-RNTI can either signal and activate the configured uplink grant, or deactivate it; i.e. a PDCCH addressed to CS-RNTI indicates that the uplink grant can be implicitly reused according to the periodicity defined by RRC, until deactivated. [278]

299. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’944 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant’s customers and end-users, in this District and elsewhere in the United States. For example, Defendant’s customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the ’944 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions,

[276] TS 38.300 V16.6.0, Section 5.2.3
[277] TS 38.300 V16.6.0, Section 10.2
[278] TS 38.300 V16.6.0, Section 10.3

documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[279] Because of Defendant's inducement, Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '944 Patent. Defendant performs these affirmative acts with knowledge of the '944 Patent and with the intent, or willful blindness, that the induced acts directly infringe the '944 Patent.

300. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '944 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant's affirmative acts of selling and offering to sell the Accused Products in this District and elsewhere in the United States and causing the Accused Products to be manufactured, used, sold, and offered for sale contributes to others' use and manufacture of the Accused Products such that the '944 Patent is directly infringed by others. The accused components within the Accused Products including, but not limited to, chipsets manufactured by Defendant, are material to the invention of the '944 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the '944 Patent. Defendant performs these affirmative acts with

---

[279] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

knowledge of the ’944 Patent and with intent, or willful blindness, that they cause the direct infringement of the ’944 Patent.

301. Defendant, with knowledge that these products, or the use thereof, infringe the ’944 Patent at least as of the date of the original Complaint in this case dated November 30, 2021, knowingly and intentionally induced, and continue to knowingly and intentionally induce direct infringement of the ’944 Patent by providing these products to end-users for use in an infringing manner.

302. ABT has suffered damages as a result of Defendant’s direct and indirect infringement of the ’944 Patent in an amount to be proved at trial.

303. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant’s infringement of the ’944 Patent, for which there is no adequate remedy at law, unless Defendant’s infringement is enjoined by this Court.

304. On information and belief, Defendant acted egregiously and with willful misconduct in that their actions constituted direct or indirect infringement of a valid patent, and this was either known or so obvious that Defendant should have known about it. Defendant continues to infringe the ’944 Patent by making, using, selling, offering for sale and/or importing in the United States the Accused Products and by inducing the direct infringing use, sale, offer for sale, and importation of the Accused Products by others, in reckless disregard of ABT’s patent rights. Defendant has committed and continues to commit acts of infringement that Defendant actually knew or should have known constituted an unjustifiably high risk of infringement of at least one valid and enforceable claim of the ’944 Patent. Upon information and belief, Defendant had actual knowledge of the ’944 Patent from related prior litigations accusing either the same products involving Defendant and products with similar 5G functionalities involving direct

competitors of Defendant. Defendant's infringement of the '944 Patent has been and continues to be willful, entitling ABT to an award of treble damages, reasonable attorney fees, and costs in bringing this action under 35 U.S.C. §§ 284 and 285.

**COUNT XVI**
**(Infringement of the '639 Patent)**

305. The preceding paragraphs are incorporated by reference as if fully set forth herein.

306. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the '639 Patent.

307. Defendant has and continues to directly infringe the '639 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '639 Patent. Such products include at least Accused Products including, but not limited to, Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which are each wireless device comprising: one or more processors; and memory storing instructions that, when executed by the one or more processors, cause the wireless device to: receive one or more radio resource control (RRC) messages comprising: a first configuration parameter, of a first semi-persistent scheduling (SPS) configuration, indicating a first hybrid automatic repeat request (HARQ) codebook identifier; a second configuration parameter, of a second SPS configuration, indicating a second HARQ codebook identifier, wherein the second HARQ codebook identifier is

the same as the first HARQ codebook identifier; and a third configuration parameter indicating a state that is mapped to the first SPS configuration and the second SPS configuration; receive a downlink control information (DCI), wherein a value of one or more bits of a HARQ process number field of the DCI indicates the state; deactivate the first SPS configuration and the second SPS configuration in response to receiving the DCI; and transmit an acknowledgment.

308. For example, Defendant has and continues to directly infringe at least claim 1 of the ’639 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards such as the Accused Products (*e.g.*, 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware for implementing 3rd Generation Partnership Product (3GPP) specifications).

309. For example, the Accused Products receive one or more radio resource control (RRC) messages.

> 5.1.2 General requirements
> The UE shall:
> 1> process the received messages in order of reception by RRC, i.e. the processing of a message shall be completed before starting the processing of a subsequent message [280]

310. For example, the Accused Products comprise a first configuration parameter of a first semi-persistent scheduling (SPS) configuration, indicating a first hybrid automatic repeat request (HARQ) codebook identifier.

[280] TS 38.331 V16.5.0, Section 5.1.2

6.3.2 Radio resource control information elements

...

– *SPS-Config*

The IE *SPS-Config* is used to configure downlink semi-persistent transmission. Multiple Downlink SPS configurations may be configured in one BWP of a serving cell.

```
SPS-Config ::= SEQUENCE {
...
harq-CodebookID-r16 INTEGER (1..2)
OPTIONAL, -- Need R
...
```

***harq-CodebookID***

Indicates the HARQ-ACK codebook index for the corresponding HARQ-ACK codebook for SPS PDSCH and ACK for SPS PDSCH release. [281]

311. For example, the Accused Products comprise a second configuration parameter of a second SPS configuration, indicating a second HARQ codebook identifier, wherein the second HARQ codebook identifier is the same as the first HARQ codebook identifier.

– *SPS-Config*

The IE *SPS-Config* is used to configure downlink semi-persistent transmission. Multiple Downlink SPS configurations may be configured in one BWP of a serving cell.

```
SPS-Config ::= SEQUENCE {
...
harq-CodebookID-r16 INTEGER (1..2)
OPTIONAL, -- Need R
...
```

***harq-CodebookID***

Indicates the HARQ-ACK codebook index for the corresponding HARQ-ACK codebook for SPS PDSCH and ACK for SPS PDSCH release. [282]

***sps-ConfigDeactivationStateList***

Indicates a list of the deactivation states in which each state can be mapped to a single or multiple SPS configurations to be deactivated, see clause 10.2 in TS 38.213 [13]. If a state is mapped to multiple SPS configurations, each of these SPS configurations is configured with the same *harq-CodebookID*. [283]

312. For example, the Accused Products comprise a third configuration parameter indicating a state that is mapped to the first SPS configuration and the second SPS configuration.

[281] TS 38.331 V16.5.0, Section 6.3.2
[282] *Id.*
[283] *Id.*

– *BWP-DownlinkDedicated*

The IE *BWP-DownlinkDedicated* is used to configure the dedicated (UE specific) parameters of a downlink BWP.

```
BWP-DownlinkDedicated ::= SEQUENCE {
...
sps-ConfigDeactivationStateList-r16 SPS-ConfigDeactivationStateList-r16
OPTIONAL, -- Need R
...
}
...
SPS-ConfigDeactivationState-r16 ::= SEQUENCE (SIZE (1..maxNrofSPSConfig-
r16)) OF SPS-ConfigIndex-r16
SPS-ConfigDeactivationStateList-r16 ::= SEQUENCE (SIZE (1..maxNrofSPSDeactivationState))
OF SPS-ConfigDeactivationState-r16
```

***sps-ConfigDeactivationStateList***

Indicates a list of the deactivation states in which each state can be mapped to a single or multiple SPS configurations to be deactivated, see clause 10.2 in TS 38.213 [13]. If a state is mapped to multiple SPS configurations, each of these SPS configurations is configured with the same *harq-CodebookID*.

[284]

313. For example, the Accused Products receive a downlink control information (DCI), wherein a value of one or more bits of a HARQ process number field of the DCI indicates the state.

5.3.1 DL Assignment reception

...

1> else if a downlink assignment for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

....

2> if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate SPS deactivation:

4> clear the configured downlink assignment for this Serving Cell (if any);

4> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is running:

5> indicate a positive acknowledgement for the SPS deactivation to the physical layer.

[285]

[284] *Id.*

[285] TS 38.321 V16.5.0, Section 5.3.1

## 4.2 Downlink

Table 4.2-1 specifies the mapping of the downlink transport channels to their corresponding physical channels. Table 4.2-2 specifies the mapping of the downlink control channel information to its corresponding physical channel.

**Table 4.2-1**

| TrCH | Physical Channel |
|---|---|
| DL-SCH | PDSCH |
| BCH | PBCH |
| PCH | PDSCH |

**Table 4.2-2**

| Control information | Physical Channel |
|---|---|
| DCI | PDCCH |

[286]

7.3.1.2.1 Format 1_0

DCI format 1_0 is used for the scheduling of PDSCH in one DL cell.

The following information is transmitted by means of the DCI format 1_0 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

...

- HARQ process number – 4 bits

7.3.1.2.2 Format 1_1

DCI format 1_1 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1_1 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

...

- HARQ process number – 4 bits

7.3.1.2.3 Format 1_2

DCI format 1_2 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1_2 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

...

- HARQ process number – 0, 1, 2, 3 or 4 bits determined by higher layer parameter *harq-ProcessNumberSizeDCI-1-2* [287]

## 10.2 PDCCH validation for DL SPS and UL grant Type 2

...

If a UE is provided more than one configuration for UL grant Type 2 PUSCH or for SPS PDSCH

- if the UE is provided *ConfiguredGrantConfigType2DeactivationStateList* or *sps-ConfigDeactivationStateList*, a value of the HARQ process number field in a DCI format indicates a corresponding entry for scheduling release of one or more UL grant Type 2 PUSCH or SPS PDSCH configurations [288]

[286] TS 38.321 V16.5.0, Section 4.2
[287] TS 38.321 V16.5.0, Section 7.3.1
[288] TS 38.213 V16.6.0, Section 10.2

6.3.2 Radio resource control information elements

...

– *BWP-DownlinkDedicated*

The IE *BWP-DownlinkDedicated* is used to configure the dedicated (UE specific) parameters of a downlink BWP.

```
BWP-DownlinkDedicated ::= SEQUENCE {
...
sps-ConfigDeactivationStateList-r16 SPS-ConfigDeactivationStateList-r16
OPTIONAL, -- Need R
...
}
...
SPS-ConfigDeactivationState-r16 ::= SEQUENCE (SIZE (1..maxNrofSPSConfig-
r16)) OF SPS-ConfigIndex-r16
SPS-ConfigDeactivationStateList-r16 ::= SEQUENCE (SIZE (1..maxNrofSPSDeactivationState))
OF SPS-ConfigDeactivationState-r16
```

***sps-ConfigDeactivationStateList***

Indicates a list of the deactivation states in which each state can be mapped to a single or multiple SPS configurations to be deactivated, see clause 10.2 in TS 38.213 [13]. If a state is mapped to multiple SPS configurations, each of these SPS configurations is configured with the same *harq-CodebookID*.

[289]

314. For example, the Accused Products deactivate the first SPS configuration and the second SPS configuration in response to receiving the DCI.

10.2 PDCCH validation for DL SPS and UL grant Type 2

...

If a UE is provided more than one configuration for UL grant Type 2 PUSCH or for SPS PDSCH

- if the UE is provided *ConfiguredGrantConfigType2DeactivationStateList* or *sps-ConfigDeactivationStateList*, a value of the HARQ process number field in a DCI format indicates a corresponding entry for scheduling release of one or more UL grant Type 2 PUSCH or SPS PDSCH configurations [290]

[289] TS 38.331 V16.5.0, Section 6.3.2

[290] TS 38.213 V16.6.0, Section 10.2

10.2 Downlink Scheduling

...

In addition, with Semi-Persistent Scheduling (SPS), the gNB can allocate downlink resources for the initial HARQ transmissions to UEs: RRC defines the periodicity of the configured downlink assignments while PDCCH addressed to CS-RNTI can either signal and activate the configured downlink assignment, or deactivate it; i.e. a PDCCH addressed to CS-RNTI indicates that the downlink assignment can be implicitly reused according to the periodicity defined by RRC, until deactivated.

...

The UE may be configured with up to 8 active configured downlink assignments for a given BWP of a serving cell. When more than one is configured:
- The network decides which of these configured downlink assignments are active at a time (including all of them); and

- Each configured downlink assignment is activated separately using a DCI command and deactivation of configured downlink assignments is done using a DCI command, which can either deactivate a single configured downlink assignment or multiple configured downlink assignments jointly. [291]

315. For example, the Accused Products transmit an acknowledgment.

10.2 PDCCH validation for DL SPS and UL grant Type 2

...

A UE is expected to provide HARQ-ACK information in response to a SPS PDSCH release after _ symbols from the last symbol of a PDCCH providing the SPS PDSCH release. If *processingType2Enabled* of *PDSCH-ServingCellConfig* is set to *enable* for the serving cell with the PDCCH providing the SPS PDSCH release, _ = 5 for _ = 0, _ = 5.5 for _ = 1, and _ = 11 for _ = 2, otherwise, _ = 10 for _ = 0, _ = 12 for _ = 1, _ = 22 for _ = 2, and _ = 25 for _ = 3, wherein _ corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH providing the SPS PDSCH release and the SCS configuration of a PUCCH carrying the HARQ-ACK information in response to a SPS PDSCH release. [292]

[291] TS 38.300 V16.6.0, Section 10.2
[292] *Id.*

5.3.1 DL Assignment reception

...

When the MAC entity has a C-RNTI, Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion during which it monitors PDCCH and for each Serving Cell:

...

1> else if a downlink assignment for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

....

2> if the NDI in the received HARQ information is 0:
3> if PDCCH contents indicate SPS deactivation:
4> clear the configured downlink assignment for this Serving Cell (if any);
4> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is running:
5> indicate a positive acknowledgement for the SPS deactivation to the physical layer. [293]

316. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '639 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant's customers and end-users, in this District and elsewhere in the United States. For example, Defendant's customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the '639 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[294] Because of Defendant's inducement,

[293] TS 38.321 V16.5.0, Section 5.3.1

[294] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-

Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '639 Patent. Defendant performs these affirmative acts with knowledge of the '639 Patent and with the intent, or willful blindness, that the induced acts directly infringe the '639 Patent.

317. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '639 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant's affirmative acts of selling and offering to sell the Accused Products in this District and elsewhere in the United States and causing the Accused Products to be manufactured, used, sold, and offered for sale contributes to others' use and manufacture of the Accused Products such that the '639 Patent is directly infringed by others. The accused components within the Accused Products including, but not limited to, chipsets manufactured by Defendant, are material to the invention of the '639 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the '639 Patent. Defendant performs these affirmative acts with knowledge of the '639 Patent and with intent, or willful blindness, that they cause the direct infringement of the '639 Patent.

318. Defendant, with knowledge that these products, or the use thereof, infringe the '639 Patent at least as of the date of the original Complaint in this case dated November 30, 2021, knowingly and intentionally induced, and continue to knowingly and intentionally induce direct infringement of the '639 Patent by providing these products to end-users for use in an infringing

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us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

manner.

319. ABT has suffered damages as a result of Defendant's direct and indirect infringement of the '639 Patent in an amount to be proved at trial.

320. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant's infringement of the '639 Patent, for which there is no adequate remedy at law, unless Defendant's infringement is enjoined by this Court.

321. On information and belief, Defendant acted egregiously and with willful misconduct in that their actions constituted direct or indirect infringement of a valid patent, and this was either known or so obvious that Defendant should have known about it. Defendant continues to infringe the '639 Patent by making, using, selling, offering for sale and/or importing in the United States the Accused Products and by inducing the direct infringing use, sale, offer for sale, and importation of the Accused Products by others, in reckless disregard of ABT's patent rights. Defendant has committed and continues to commit acts of infringement that Defendant actually knew or should have known constituted an unjustifiably high risk of infringement of at least one valid and enforceable claim of the '639 Patent. Upon information and belief, Defendant had actual knowledge of the '639 Patent from related prior litigations accusing either the same products involving Defendant and products with similar 5G functionalities involving direct competitors of Defendant. Defendant's infringement of the '639 Patent has been and continues to be willful, entitling ABT to an award of treble damages, reasonable attorney fees, and costs in bringing this action under 35 U.S.C. §§ 284 and 285.

## COUNT XVII
## (Infringement of the '695 Patent)

322. The preceding paragraphs are incorporated by reference as if fully set forth herein.

323. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the ’695 Patent.

324. Defendant has and continues to directly infringe the ’695 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by using the Accused Products to perform the claimed method(s) of the ’695 Patent. Such products include at least Accused Products including, but not limited to, Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which practice a method comprising: receiving, by a wireless device, uplink cancellation configuration parameters comprising: a cancellation indication radio network temporary identifier (RNTI); and a sequence of serving cell-specific parameters comprising: an identifier of a serving cell; a first parameter indicating a first starting position in a downlink control information (DCI) for the serving cell; and a second parameter indicating a second starting position in a DCI for a supplementary uplink carrier of the serving cell; receiving a first DCI, associated with the cancellation indication RNTI, comprising cancellation indications; determining a first cancellation indication, in the cancellation indications, based on: the first starting position, in a first number of bit, when a scheduled uplink transmission is for a normal uplink carrier of the serving cell; and the second starting position, in a second number of bit, when the scheduled uplink transmission is for the supplementary uplink carrier of the serving cell; wherein the first number of bit and the second number of bit are based on a payload size of the first DCI; and cancelling the scheduled uplink

transmission based on the first cancellation indication.

325. For example, Defendant has and continues to directly infringe at least claim 1 of the '695 Patent by using products that implement the 5G standards, such as the Accused Products (*e.g.*, 5G mobile handsets and tablets) to perform the claimed method(s).

326. For example, the Accused Products practice receiving, by a wireless device, uplink cancellation configuration parameters (*e.g.*, an "IE UplinkCancellation is used to configure the UE to monitor PDCCH for the CI-RNTI") comprising: a cancellation indication radio network temporary identifier (RNTI) (*e.g.*, a ci-RNTI "used for indication cancellation in UL").[295]

327. For example, the Accused Products practice a receiving, by a wireless device, uplink cancellation configuration parameters (e.g., an "IE UplinkCancellation is used to configure the UE to monitor PDCCH for the CI-RNTI") comprising: a sequence of serving cell-specific parameters (*e.g.*, "CI-ConfigurationPerServingCell-r16" which is a sequence of serving cell-specific parameters) comprising: an identifier of a serving cell (*e.g.*, a "servingCellId" is an identifier of a serving cell); a first parameter indicating a first starting position in a downlink control information (DCI) for the serving cell (*e.g.*, a "positioninDCI" which is a first parameter that indicates "starting position (in number of bit) of the ci-PayloadSize bit CI value applicable for this serving cell (servingCellId) within the DCI payload"); and a second parameter indicating a second starting position in a DCI for a supplementary uplink carrier of the serving cell (*e.g.*, a "positioninDCI-ForSUL" is a second parameter that indicates "starting position (in number of bit) of the ci-PayloadSize bit CI value applicable for SUL of this serving cell (servingCellId) within the DCI payload").296

[295] *See* TS 38.331 V16.5.0, Sections 5.1.2, 6.3.2; TS 38.213 V16.6.0, Section 11.2A.
[296] *Id.*

328. For example, the Accused Products practice receiving a first DCI (*e.g.*, "detection of a DCI format 2_4), associated with the cancellation indication RNTI (e.g., DCI format 2_4 is transmitted "with CRC scrambled by ci-RNTI"), comprising cancellation indications (*e.g.*, "Cancellation indication 1, Cancellation indication 2, . . ., Cancellation indication N.).[297]

329. For example, the Accused Products practice determining a first cancellation indication, in the cancellation indications (*e.g.*, ci-PayloadSize that "configures the field size for each UL cancellation indicator of this serving cell (servingCellId)"), based on: the first starting position, in a first number of bit, when a scheduled uplink transmission is for a normal uplink carrier of the serving cell (*e.g.*, positionInDCI which indicates "starting position (in number of bit) of the ci-PayloadSize bit CI value applicable for this serving cell (servingCellId) within the DCI payload").[298]

330. For example, the Accused Products practice determining a first cancellation indication, in the cancellation indications (*e.g.*, ci-PayloadSize that "configures the field size for each UL cancellation indicator of this serving cell (servingCellId)"), based on: the second starting position, in a second number of bit, when the scheduled uplink transmission is for the supplementary uplink carrier of the serving cell (*e.g.*, positionInDCI-ForSUL which indicates "starting position (in number of bit) of the ci-PayloadSize bit CI value applicable for SUL [supplementary uplink] of this serving cell (servingCellId) within the DCI payload").[299]

331. For example, the Accused Products practice a method wherein the first number of bit and the second number of bit are based on a payload size of the first DCI (*e.g.*, dci-

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[297] *See* TS 38.212 V16.6.0, Section 7.3.1; TS 38.213 V16.6.0, Section 11.2A.
[298] *See* TS 38.331 V16.5.0, Sections 6.3.2, 6.4; TS 38.300 V16.6.0, Section 5.4.2; TS 38.321 V16.5.0, Section 5.16.
[299] *Id.*

PayloadSizeForCI which indicates the "total length of the DCI payload scrambled with CI-RNTI").300

332. For example, the Accused Products practice cancelling the scheduled uplink transmission based on the first cancellation indication (*e.g.*, "[t]he gNB can configure UEs to monitor cancelled transmission indications using CI-RNTI on a PDCCH" and "[i]f a UE receives the cancelled transmission indication, the UE shall cancel the PUSCH transmission from the earliest symbol overlapped with the resource or the SRS transmission overlapped with the resource indicated by cancellation).301

333. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '695 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant's customers and end-users, in this District and elsewhere in the United States. For example, Defendant's customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the ' 695 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.302 Because of Defendant's inducement,

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[300] *Id.*
[301] *See* TS 38.300 V16.6.0, Section 10.3.
[302] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-

Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '695 Patent. Defendant performs these affirmative acts with knowledge of the '695 Patent and with the intent, or willful blindness, that the induced acts directly infringe the ' 695 Patent.

334. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '695 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant's affirmative acts of selling and offering to sell the Accused Products in this District and elsewhere in the United States and causing the Accused Products to be manufactured, used, sold, and offered for sale contributes to others' use and manufacture of the Accused Products such that the '695 Patent is directly infringed by others. The accused components within the Accused Products including, but not limited to, chipsets manufactured by Defendant, are material to the invention of the '695 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the '695 Patent. Defendant performs these affirmative acts with knowledge of the '695 Patent and with intent, or willful blindness, that they cause the direct infringement of the '695 Patent.

335. Defendant, with knowledge that these products, or the use thereof, infringe the '695 Patent at least as of the date of the original Complaint in this case dated November 30, 2021, knowingly and intentionally induced, and continue to knowingly and intentionally induce direct infringement of the '695 Patent by providing these products to end-users for use in an infringing

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get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

manner.

336. ABT has suffered damages as a result of Defendant's direct and indirect infringement of the '695 Patent in an amount to be proved at trial.

337. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant's infringement of the '695 Patent, for which there is no adequate remedy at law, unless Defendant's infringement is enjoined by this Court.

338. On information and belief, Defendant acted egregiously and with willful misconduct in that their actions constituted direct or indirect infringement of a valid patent, and this was either known or so obvious that Defendant should have known about it. Defendant continues to infringe the '695 Patent by using the Accused Products to perform the claimed method(s) and by inducing the direct infringing use, sale, offer for sale, and importation of the Accused Products by others, in reckless disregard of ABT's patent rights. Defendant has committed and continues to commit acts of infringement that Defendant actually knew or should have known constituted an unjustifiably high risk of infringement of at least one valid and enforceable claim of the '695 Patent. Upon information and belief, Defendant had actual knowledge of the '695 Patent from related prior litigations accusing either the same products involving Defendant and products with similar 5G functionalities involving direct competitors of Defendant. Defendant's infringement of the '695 Patent has been and continues to be willful, entitling ABT to an award of treble damages, reasonable attorney fees, and costs in bringing this action under 35 U.S.C. §§ 284 and 285.

**COUNT XVIII**
**(Infringement of the '128 Patent)**

339. The preceding paragraphs are incorporated by reference as if fully set forth herein.

340. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the ’128 Patent.

341. Defendant has and continues to directly infringe the ’128 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by using the Accused Products to perform the claimed method(s) of the ’128 Patent. Such products include at least Accused Products including, but not limited to, Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which practice a method comprising: receiving, by a wireless device, one or more messages comprising: first configuration parameters for beam failure recovery, comprising first random access parameters; second configuration parameters for listen-before-talk (LBT) failure recovery; and second random access parameters; initiating, based on the first configuration parameters and in response to detecting a beam failure on a primary cell, a first random access process on a first bandwidth part (BWP) of the primary cell for beam failure recovery based on the first random access parameters; triggering, based on the second configuration parameters, consistent LBT failure for the primary cell; stopping the first random access process, for the beam failure recovery, based on triggering the consistent LBT failure; switching from the first BWP of the primary cell to a second BWP of the primary cell as an active BWP of the primary cell; and initiating a second random access process on the second BWP of the primary cell for consistent LBT failure recovery and based on the second random access parameters.

342. For example, Defendant has and continue to directly infringe at least claim 1 of the ’128 Patent by using products that implement the 5G standards, such as the Accused Products (*e.g.,* 5G mobile handsets and tablets) to perform the claimed method(s).

343. For example, the Accused Products practice a method comprising receiving, by a wireless device, one or more messages comprising: first configuration parameters for beam failure recovery, comprising first random access parameters (*e.g.*, “BeamFailureRecoveryConfig” which is “used to configure the UE with RACH resources and candidate beams for beam failure recovery in case of beam failure detection” and comprises first random access parameters such as “ra-prioritization,” “ra-PrioritizationTwoStep,” “ra-ssb-OccasionMaskIndex,” “rootSequenceIndex-BFR,” and “ssb-perRach-Occasion”); second configuration parameters for listen-before-talk (LBT) failure recovery (*e.g.*, LBT-FailureRecoveryConfig which is used to configure the parameters used for detection of consistent uplink LBT failures for operation with shared spectrum channel access, such as “Ibt-FailureDetectionTimer” and “Ibt-FailureInstanceMaxCount”); and second random access parameters (*e.g.*, RACH-ConfigDedicated which is used to specify the dedicated random access parameters such as “ssb-perRach-Occasion,” “ra-ssb-OccasionMaskIndex,” “ra-prioritization,” and “ra-PrioritizationTwoStep”).[303]

344. For example, the Accused Products practice a method comprising initiating, based on the first configuration parameters (*e.g.*, “BeamFailureRecoveryConfig” which is “used to configure the UE with RACH resources and candidate beams for beam failure recovery in case of beam failure detection”) and in response to detecting a beam failure on a primary cell, a first random access process (*e.g.*, “[a]fter beam failure is detected on PCell, the UE: triggers beam failure recovery by initiating a Random Access procedure on the PCell”) on a first bandwidth part

[303] *See* TS 38.331 V16.5.0, Sections 5.1.2, 6.3.2; TS 38.321 V16.5.0, Sections 5.17, 5.21.

(BWP) of the primary cell for beam failure recovery based on the first random access parameters (*e.g.*, "[a] UE [is] configured for operation in bandwidth parts (BWPs) of a serving cell").304

345. For example, the Accused Products practice a method comprising triggering, based on the second configuration parameters, consistent LBT failure for the primary cell (*e.g.*, "trigger consistent LBT failure for the active UL BWP in this Serving Cell" based on configured parameters in the lbt-FailureRecoveryConfig such as "lbt-FailureInstanceMaxCount for the consistent LBT failure detection" and "lbt-FailureDetectionTimer for the consistent LBT failure detection").305

346. For example, the Accused Products practice a method comprising stopping the first random access process, for the beam failure recovery, based on triggering the consistent LBT failure (*e.g.*, an "LBT failure detection and recovery procedure where, "if this Serving Cell is the SpCell," "stop any ongoing Random Access procedure in this Serving Cell").[306]

347. For example, the Accused Products practice a method comprising switching from the first BWP of the primary cell to a second BWP of the primary cell as an active BWP of the primary cell (*e.g.*, "switch the active UL BWP to an UL BWP, on same carrier in this Serving Cell").307

348. For example, the Accused Products practice a method comprising initiating a second random access process on the second BWP of the primary cell for consistent LBT failure recovery (*e.g.*, an "LBT failure detection and recovery procedure which "initiate[s] a Random

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[304] *See* TS 38.300 V16.6.0, Section 9.2, TS 38.321 V16.5.0, Sections 3.1, 3.2, 5.17; TS 38.331 V16.5.0, Section 6.3.2; TS 38.213 V16.6.0, Section 12.
[305] TS 38.321 V16.5.0, Section 5.21.2.
[306] TS 38.321 V16.5.0, Section 5.21.2; TS 38.300 V16.6.0, Section 5.6, 9.2.6; TS 38.331 V16.5.0, Section 6.3.2.
[307] *Id.*

Access Procedure" and where "[t]he random access procedure is triggered by a number of events" including "[c]onsistent UL LBT failure on SpCell") and based on the second random access parameters (*e.g.*, second random access process parameters are configured via IEs other than BeamFailureRecoveryConfig such as via RACH-ConfigDedicated or RACH-ConfigCommon).[308]

349. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '128 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant's customers and end-users, in this District and elsewhere in the United States. For example, Defendant's customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the '128 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.[309] Because of Defendant's inducement, Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '128 Patent. Defendant performs these affirmative acts with knowledge of the '128 Patent and with the intent, or willful blindness, that the induced acts directly infringe

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[308] *Id.*

[309] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

the ’527 Patent.

350. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’128 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant’s affirmative acts of selling and offering to sell the Accused Products in this District and elsewhere in the United States and causing the Accused Products to be manufactured, used, sold, and offered for sale contributes to others’ use and manufacture of the Accused Products such that the ’128 Patent is directly infringed by others. The accused components within the Accused Products including, but not limited to, chipsets manufactured by Defendant, are material to the invention of the ’128 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the ’128 Patent. Defendant performs these affirmative acts with knowledge of the ’128 Patent and with intent, or willful blindness, that they cause the direct infringement of the ’128 Patent.

351. Defendant, with knowledge that these products, or the use thereof, infringe the ’128 Patent at least as of the date of the original Complaint in this case dated November 30, 2021, knowingly and intentionally induced, and continue to knowingly and intentionally induce direct infringement of the ’128 Patent by providing these products to end-users for use in an infringing manner.

352. ABT has suffered damages as a result of Defendant’s direct and indirect infringement of the ’128 Patent in an amount to be proved at trial.

353. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant's infringement of the '128 Patent, for which there is no adequate remedy at law, unless Defendant's infringement is enjoined by this Court.

354. On information and belief, Defendant acted egregiously and with willful misconduct in that their actions constituted direct or indirect infringement of a valid patent, and this was either known or so obvious that Defendant should have known about it. Defendant continue to infringe the '128 Patent by using the Accused Products to perform the claimed method(s) and by inducing the direct infringing use, sale, offer for sale, and importation of the Accused Products by others, in reckless disregard of ABT's patent rights. Defendant has committed and continue to commit acts of infringement that Defendant actually knew or should have known constituted an unjustifiably high risk of infringement of at least one valid and enforceable claim of the '128 Patent. Upon information and belief, Defendant had actual knowledge of the '128 Patent from related prior litigations accusing either the same products involving Defendant and products with similar 5G functionalities involving direct competitors of Defendant. Defendant's infringement of the '128 Patent has been and continues to be willful, entitling ABT to an award of treble damages, reasonable attorney fees, and costs in bringing this action under 35 U.S.C. §§ 284 and 285.

## COUNT XIX
## (Infringement of the '615 Patent)

355. The preceding paragraphs are incorporated by reference as if fully set forth herein.

356. ABT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the '615 Patent.

357. Defendant has and continues to directly infringe the '615 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making,

using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the ’615 Patent. Such products include at least Accused Products including, but not limited to, the iPhone 15, iPhone 15 Plus, iPhone 15 Pro, iPhone 15 Pro Max, iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max, iPhone SE (2022), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPad Pro 12.9-inch (5th generation or later), iPad Pro 11-inch (3rd generation or later), iPad Air (5th generation), iPad mini (6th generation), and iPad (10th generation) which practice a wireless device comprising: one or more processors; and memory storing instructions that, when executed by the one or more processors, cause the wireless device to: receive configuration parameters comprising first random access parameters, for beam failure recovery, and second random access parameters; initiate, based on the first random access parameters and in response to detecting a beam failure, a first random access process on a first bandwidth part (BWP) of a primary cell; stop the first random access process in response to triggering consistent listen-before-talk (LBT) failure for the primary cell; switch from the first BWP to a second BWP of the primary cell as an active BWP; initiate a second random access process on the second BWP for consistent LBT failure recovery and based on the second random access parameters; and initiate a third random access process for beam failure recovery after the second random access process is successfully completed.

358. For example, Defendant has and continues to directly infringe at least claim 9 of the ’615 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement the 5G standards such as the Accused Products (*e.g.*, 5G mobile handsets and tablets). For example, the Accused Products operate on 5G networks and includes firmware for implementing 3rd Generation Partnership Product (3GPP) specifications).

359. For example, the Accused Products receive configuration parameters comprising first random access parameters (*e.g.*, "BeamFailureRecoveryConfig" which is "used to configure the UE with RACH resources and candidate beams for beam failure recovery in case of beam failure detection" and comprises first random access parameters such as "ra-prioritization," "ra-PrioritizationTwoStep," "ra-ssb-OccasionMaskIndex," "rootSequenceIndex-BFR," and "ssb-perRach-Occasion"); and second random access parameters (*e.g.*, RACH-ConfigDedicated which is used to specify the dedicated random access parameters such as "ssb-perRach-Occasion," "ra-ssb-OccasionMaskIndex," "ra-prioritization," and "ra-PrioritizationTwoStep").[310]

360. For example, the Accused Products initiate, based on the first configuration parameters and in response to detecting a beam failure (*e.g.*, "BeamFailureRecoveryConfig" which is "used to configure the UE with RACH resources and candidate beams for beam failure recovery in case of beam failure detection"), a first random access process (*e.g.*, "[a]fter beam failure is detected on PCell, the UE: triggers beam failure recovery by initiating a Random Access procedure on the PCell") on a first bandwidth part (BWP) of a primary cell (*e.g.*, "[a] UE [is] configured for operation in bandwidth parts (BWPs) of a serving cell").[311]

361. For example, the Accused Products stop the first random access process in response to triggering (*e.g.*, "trigger consistent LBT failure for the active UL BWP in this Serving Cell" based on configured parameters in the lbt-FailureRecoveryConfig such as "lbt-FailureInstanceMaxCount for the consistent LBT failure detection" and "lbt-FailureDetectionTimer for the consistent LBT failure detection") consistent listen-before-talk (LBT) failure for the primary cell (*e.g.*, an "LBT failure detection and recovery procedure where,

[310] *See* TS 38.331 V16.5.0, Sections 5.1.2, 6.3.2; TS 38.321 V16.5.0, Sections 5.17, 5.21.
[311] *See* TS 38.300 V16.6.0, Section 9.2, TS 38.321 V16.5.0, Sections 3.1, 3.2, 5.17; TS 38.331 V16.5.0, Section 6.3.2; TS 38.213 V16.6.0, Section 12

"if this Serving Cell is the SpCell," "stop any ongoing Random Access procedure in this Serving Cell").[312]

362. For example, the Accused Products switch from the first BWP to a second BWP of the primary cell as an active BWP (*e.g.*, "switch the active UL BWP to an UL BWP, on same carrier in this Serving Cell").[313]

363. For example, the Accused Products initiate a second random access process on the second BWP for consistent LBT failure recovery (*e.g.*, an "LBT failure detection and recovery procedure which "initiate[s] a Random Access Procedure" and where "[t]he random access procedure is triggered by a number of events" including "[c]onsistent UL LBT failure on SpCell") and based on the second random access parameters (*e.g.*, second random access process parameters are configured via IEs other than BeamFailureRecoveryConfig such as via RACH-ConfigDedicated or RACH-ConfigCommon).[314]

364. For example, the Accused Products initiate a third random access process for beam failure recovery ("initiate a Random Access procedure (*see* clause 5.1) on the SpCell"; "There is only one Random Access procedure ongoing at any point in time in a MAC entity") after the second random access process is successfully completed ("if BFI_COUNTER >= beamFailureInstanceMaxCount").[315]

365. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '615 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant's customers and end-users, in this District and elsewhere in the United States.

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[312] TS 38.321 V16.5.0, Section 5.21.2; TS 38.300 V16.6.0, Section 5.6, 9.2.6; TS 38.331 V16.5.0, Section 6.3.2.
[313] *Id.*
[314] *Id.*
[315] TS 38.321 V16.5.0, Section 5.1.

For example, Defendant's customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the '615 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation.316 Because of Defendant's inducement, Defendant's customers and end-users use the Accused Products in a way Defendant intends and they directly infringe the '615 Patent. Defendant performs these affirmative acts with knowledge of the '615 Patent and with the intent, or willful blindness, that the induced acts directly infringe the '615 Patent.

366. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '615 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant's affirmative acts of selling and offering to sell the Accused Products in this District and elsewhere in the United States and causing the Accused Products to be manufactured, used, sold, and offered for sale contribute to others' use and manufacture of the Accused Products such that the '615 Patent is directly infringed by others. The accused components within the Accused

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[316] *See e.g.,* https://www.apple.com/iphone-14/; https://www.apple.com/iphone-14/specs/; https://www.apple.com/ipad-pro/; https://www.apple.com/ipad-pro/specs/; https://support.apple.com/iphone; https://support.apple.com/ipad; https://support.apple.com/en_US/manuals/iphone; https://support.apple.com/en_US/manuals/ipad; https://www.apple.com/retail/; https://support.apple.com/iphone/repair; https://support.apple.com/repair?cid=gn-ols-repair-lp-get_help; https://support.apple.com/en-us/HT211828; https://support.apple.com/en-us/HT212196#:~:text=Go%20to%20Settings%20%3E%20Cellular%20%3E%20Cellular,5G%20service%2C%20contact%20your%20carrier

Products including, but not limited to, chipsets manufactured by Defendant, are material to the invention of the ’615 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the ’615 Patent. Defendant performs these affirmative acts with knowledge of the ’615 Patent and with intent, or willful blindness, that they cause the direct infringement of the ’615 Patent.

367. Defendant, with knowledge that these products, or the use thereof, infringe the ’615 Patent at least as of the date of the original Complaint in this case dated November 30, 2021, knowingly and intentionally induced, and continue to knowingly and intentionally induce direct infringement of the ’615 Patent by providing these products to end-users for use in an infringing manner.

368. ABT has suffered damages as a result of Defendant’s direct and indirect infringement of the ’615 Patent in an amount to be proved at trial.

369. ABT has suffered, and will continue to suffer, irreparable harm as a result of Defendant’s infringement of the ’615 Patent, for which there is no adequate remedy at law, unless Defendant’s infringement is enjoined by this Court.

370. On information and belief, Defendant acted egregiously and with willful misconduct in that their actions constituted direct or indirect infringement of a valid patent, and this was either known or so obvious that Defendant should have known about it. Defendant continues to infringe the ’615 Patent by making, using, selling, offering for sale and/or importing in the United States the Accused Products and by inducing the direct infringing use, sale, offer for sale, and importation of the Accused Products by others, in reckless disregard of ABT’s patent rights. Defendant has committed and continues to commit acts of infringement that Defendant

actually knew or should have known constituted an unjustifiably high risk of infringement of at least one valid and enforceable claim of the ’615 Patent. Upon information and belief, Defendant had actual knowledge of the ’615 Patent from related prior litigations accusing either the same products involving Defendant and products with similar 5G functionalities involving direct competitors of Defendant. Defendant’s infringement of the ’615 Patent has been and continues to be willful, entitling ABT to an award of treble damages, reasonable attorney fees, and costs in bringing this action under 35 U.S.C. §§ 284 and 285.

## DEMAND FOR JURY TRIAL

Plaintiff hereby demands a jury for all issues so triable.

## PRAYER FOR RELIEF

WHEREFORE, ABT prays for relief against Defendant as follows:

a. An adjudication that Defendant has breached its FRAND obligations to Plaintiff;

b. An award of damages to be paid by Defendant adequate to compensate Plaintiff for damages suffered from its breach of FRAND obligations;

c. An adjudication that Defendant has been unjustly enriched;

d. An award of restitution to compensate Plaintiff for Defendant’s unjust enrichment;

e. Entry of judgment declaring that Defendant has directly and/or indirectly infringed one or more claims of each of the Patents-in-Suit;

f. An order pursuant to 35 U.S.C. § 283 permanently enjoining Defendant, their officers, agents, servants, employees, attorneys, and those persons in active concert or participation with it, from further acts of infringement of the Patents-in-Suit;

g. An order awarding damages sufficient to compensate ABT for Defendant’s infringement of the Patents-in-Suit, but in no event less than a reasonable royalty, together with interest and costs;

h. Entry of judgment declaring that this case is exceptional and awarding ABT its costs and reasonable attorney fees under 35 U.S.C. § 285; and

i. An award to Plaintiff of such further relief at law or equity as the Court deems just and proper.

Dated: May 2, 2024

Respectfully submitted,

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